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EDITORIAL

THE ARTIST VIEWS AMERICAN MEDICAL PIONEERS

THE Interstate Post-Graduate Medical Assembly this fall introduced to the medical profession and to the public at large the first of a series of paintings commemorating notable figures in American medicine. Dean Cornwell, noted American illustrator and mural painter, has set out to familiarize Americans with the achievements of American pioneers in the medical arts: Beaumont, the father of modern experimental physiology; Ephraim McDowell, the father of abdominal surgery; Dorothea Lynde Dix, crusader for improved conditions for the feeble-minded and insane; Oliver Wendell Holmes, who brought to light the contagiousness of childbed fever; Crawford W. Long and William Thomas Green Morton, first to use anesthesia; and Walter Reed, investigator of yellow fever. These men deserve a place as noteworthy as the familiarity already accorded the great Europeans, Lister, Pasteur, Jenner, et al.

Mr. Cornwell's first painting depicts the work of William Beaumont, the army surgeon who developed much of our knowledge of gastric physiology through his study of Alexis St. Martin, the man with "a lid on his stomach." The famous accidental fistula from which St. Martin suffered enabled Beaumont to record the movements of his stomach during digestion, the normal appearance of the gastric mucosa, the effect of temperature and emotional factors upon the flow of the gastric juice, the results of starvation, over-feeding, mastication, and the fact that only the taking of food, and not mechanical irritation, stimulates gastric secretion. That Beaumont lacked scientific education, university degrees and laboratory facilities seemed never to prevent him from perceiving the significance of an accidental finding and developing to the utmost the opportunity which had come his way.

The fistula method, originated accidentally through gun-

shot, has since been perfected by Pavlov and his school. The data accumulated by Beaumont have since been expanded into a large and growing body of knowledge. That his contribution should at last be popularly recognized and the drama of his story known to millions is a belated tribute.

The artistic merits of Mr. Cornwell's painting must be left for others to discuss. We have from the artist himself the assurance that he spent many months in research in order to portray the characters and the locale of the experiment with accuracy and fidelity. As a result, the historian will appreciate his work, and millions of Americans will find in it an interesting illumination of a phase of American history thus far little studied.

T. S. W.

GEORGE WILKINS SWIFT

IT is with regret that we announce the sudden death on December 18, 1938 of George Wilkins Swift of Seattle, nationally known surgeon and member of the Editorial Board of The American Journal of Surgery.

Dr. Swift since his graduation from Northwestern University Medical School in 1907 has risen far in the neurosurgical field. He was a fellow and member of the board of governors of the American College of Surgeons, a past president of the Pan-Pacific Surgical Association, the Pacific Northwest Medical Association and the Public Health League of Washington. His many contributions to this and other journals have established his reputation as an authority on neurosurgery. Only two weeks before his death, his last article was published in the December number of The American Journal of Surgery.

To his relatives we, in the name of The American Journal of Surgery, offer our deepest expression of sympathy.

T. S. W.

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ORIGINAL ARTICLES

A NEW METHOD OF JOINT MEASUREMENT AND A REVIEW OF THE LITERATURE

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IT is the purpose of this paper to introduce a system of measurement which, it is hoped, will simplify and standardize methods of measuring joint motion, since there seems to be some confusion and disagreement among physicians and physical therapy technicians regarding terminology, methods and instruments for measuring and recording joint motion.

Accurate measurements of joint motion furnish objective facts on which the physician may gauge improvement or lack of improvement during treatment instead of relying on subjective impressions. Also, by means of accurate measurements of the amplitude, strength and rapidity of movement in the impaired joint, the patient is shown the nature and rate of his recovery. One of the greatest values of joint measurement lies in its physiologic effect on the patient in interesting him in the progress of his own case. The initial measurements (Fig. 1) show him the extent and the nature of his injuries as compared with the normal; succeeding measurements show him how rapidly he is improving and indicate how long treatment will be necessary. In daily practice, therefore, such measurements furnish the best possible guide to the direction of the treatment itself, and, finally, when the treatment is completed, they furnish reliable data by which the results can be stated.

The need for accurate instruments and methods of measuring and recording joint motion was best seen during and after the World War when so many disabilities had to be treated and recorded. Today there is just as great a need for accurate reports. Those in charge in various industries are demanding reports on all injuries sustained by their employees. They want to know the extent of the injury, the length of time the employee will be absent from work and the progress he is making under treatment. The physician must be able to give such a report on the condition and progress of his patient, and he must give his report in such a manner that it will be understood by everyone who reads it. Measurement of the range of motion in a joint is also the objective test of disablement and is indispensable in medicolegal work. Rosén has stated that: "Exact knowledge of the extent of disability present is of paramount value in medical reports. Laws providing compensation for injuries sustained in industry are now becoming well nigh universal, and the physician is often the sole arbiter as to the amount of disability present. The justice of the compensation awarded depends on the accuracy of the records."

A recent survey of the literature has revealed a variety of methods for measuring the limits of motion or the angle of deformity in joints. A few physicians have worked out systems of measurement and methods of recording joint motion which they uniformly use, and these methods,

once explained, are intelligible and can be clearly understood. It was found, however, that the majority of physicians gave little thought to the matter. When the necessity arose they gave visual approximations or quickly devised a method to measure motion in the joint, with the result that no one but the particular physician himself could interpret such measurements; indeed it is doubtful whether even he, after a lapse of time, could have understood his own records. In addition, the recent literature was found to contain very little data concerning the measuring and recording of joint function.

On a recent tour of a number of Eastern hospitals inquiry was made concerning methods of measuring joint motion, the types of instruments used for this purpose, and methods of recording such measurements. In most of the departments of physical therapy that were visited it was found that no definite system was used and that, as a rule, no records of joint measurements were kept. The range of motion in an affected joint was usually approximated visually.

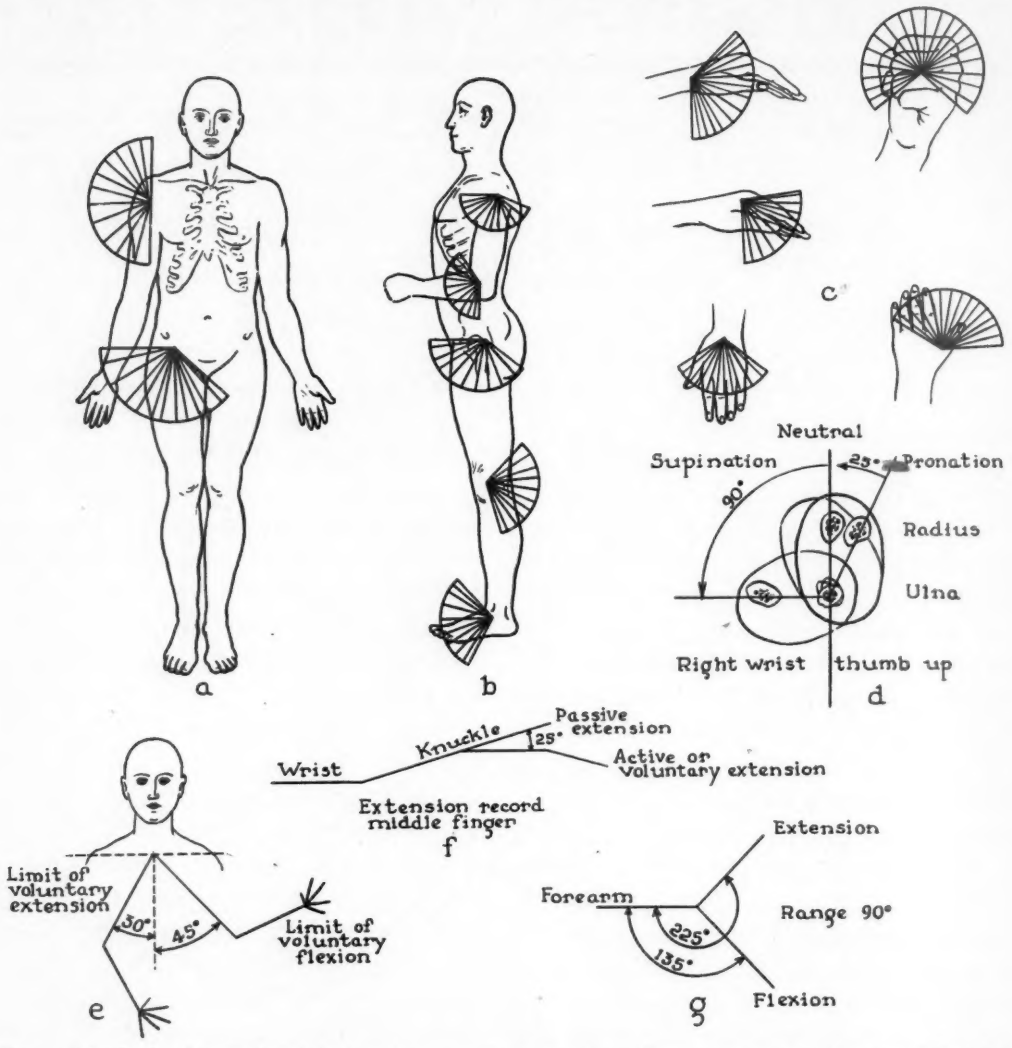

Fig. 1. Methods of recording joint motion: A, B, C, Fox and van Breeman; D, E, F, Nutter; G, Rosén.

Existing methods for measuring and recording joint motion vary considerably and, when grouped together, may be very confusing. Of the methods of joint measurement described in the literature those of Clark,[3] Robinson,[12] Silver,[14] Rosén,[13] and Cave and Roberts[2] seem to be most clear

and systematic; yet even among these authors there was a wide variation in methods and in nomenclature. Nearly all of these men agreed that there should be a neutral point from which measurements should begin, but there was a difference in opinion as to what this neutral point should be: Clark, for example, called his starting position, "a straight line or an extension of the joint," the part distal to the joint concerned pointing toward the toes and being parallel to the lateral plane of the body. Cave and Roberts, on the other hand, stated that, "the joints are not always in extension and the neutral position must be defined." Robinson called his starting point, "the base line and axis of motion in each joint." In his system the long axis of the proximal bone member of the joint under observation was the base line and crossed the axis of motion at a right angle. Rosén did not believe that a definite starting point or neutral position was possible, stating that, "of most concern is the size of the angles subtended at the two extremes of excursions of the joint; the difference between these two gives the range of motion, which, when compared with the normal, expresses the disability present." Silver, on the other hand, proposed that "mensuration of the degrees of motion in joints should start from a zero plane. The zero plane shall be considered to be an extension of the plane of the long bone or bones immediately proximal to the joint in question."

There was likewise found to be a difference of opinion among these same authors concerning the normal range of joint motion. (Table I.) From this table it can be seen that each gives different figures to describe the range of motion in the same joint. It is just for this reason that such confusion exists in the literature on joint measurement. It is particularly to be desired that a starting figure be agreed on, since if there is any difference in this figure it naturally follows that there will be a difference in the resultant combinations even when the same amount of movement is expressed, and figures for describing the range of motion will vary according to whether the measurement starts from extreme flexion or extension or from some other starting point. In one report, for example, the angle subtended by the hand and forearm when in a straight line was considered as zero; in another it was called 180 degrees. Some authors compute the range of supination from full pronation; others from mid-pronation. It would probably be wiser to state that the degrees of normal motion are approximate, as ranges of motion will vary in different individuals. A range of motion which may be normal in one will not be possible in another. The normal range of movement will depend, therefore, on the age, sex, habits and occupation of the individual.

There was also confusion regarding the terms used to describe the many movements of the bony articulations of the

TABLE I

VARIOUS METHODS GIVEN TO DESCRIBE THE NORMAL RANGE OF JOINT MOTION

	Silver		Clark		Robinson		Rosén	
	Flexion	Extension	Flexion	Extension	Flexion	Extension	Flexion	Extension
Elbow	140°	0°	30°	180°	55–45°	180°		
Wrist	70°	70°	100°	180°	110°	145°	135°	225°
Hip	130°	0°	60°	180°	60–50°	135°		

body. In the case of almost every joint studied a variety of terms was used to describe the same movement. For example, "inferior" or "superior," "adduction" or "abduction" were used in contexts where the meaning was by no means clear. In

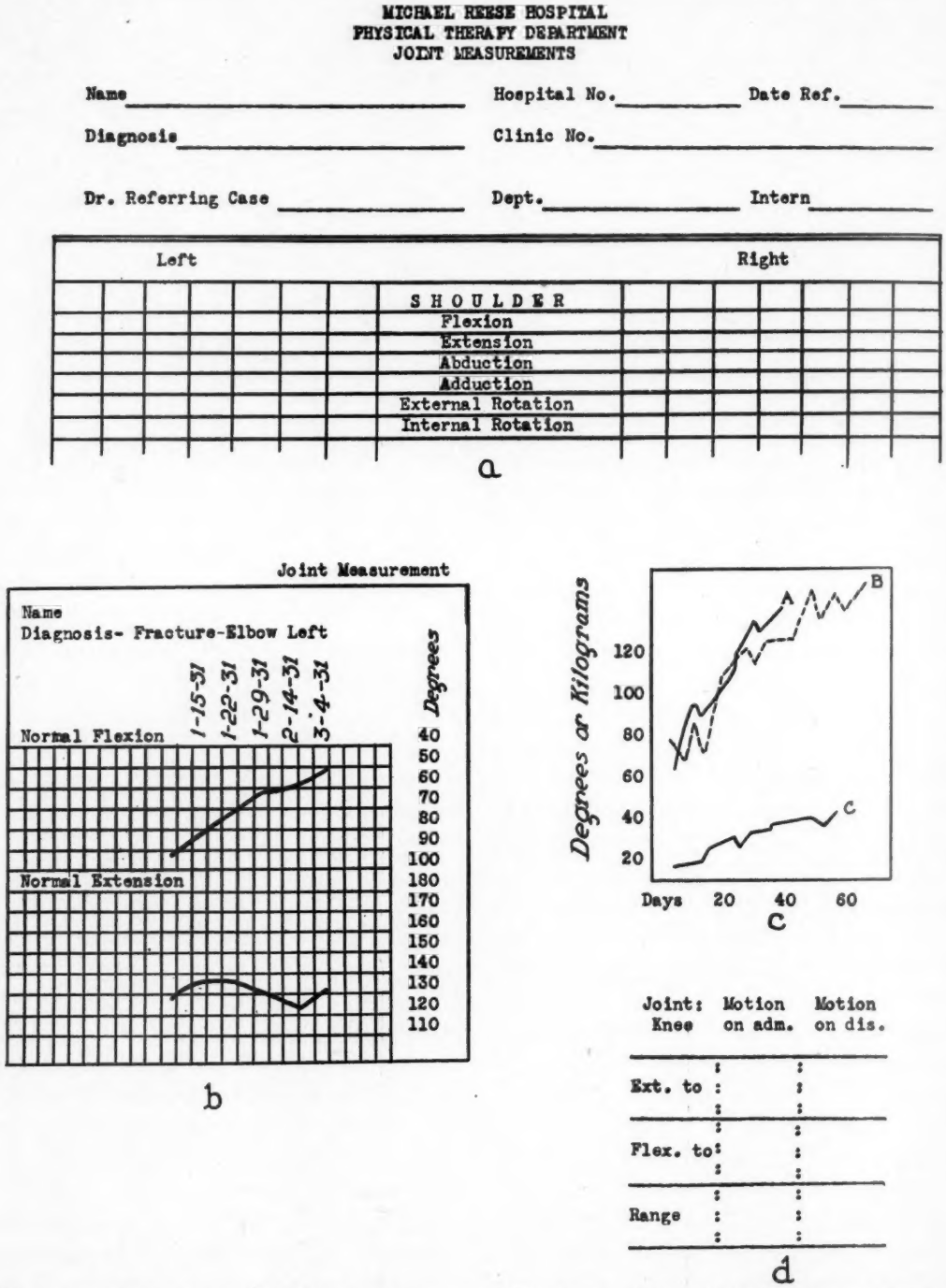

FIG. 2. Methods of recording joint motion: A, B, Molander; C, Albee and Gilliland; D, Krusen.

thirty-seven different terms were applied to movements of the humerus alone. Such terms as "coronal," "sagittal" and "median" planes; the "pivotal position"; and addition, such terms as "circumduction," "rotation," "elevation," "flexion," and the "neutral position" were too frequently used ambiguously.

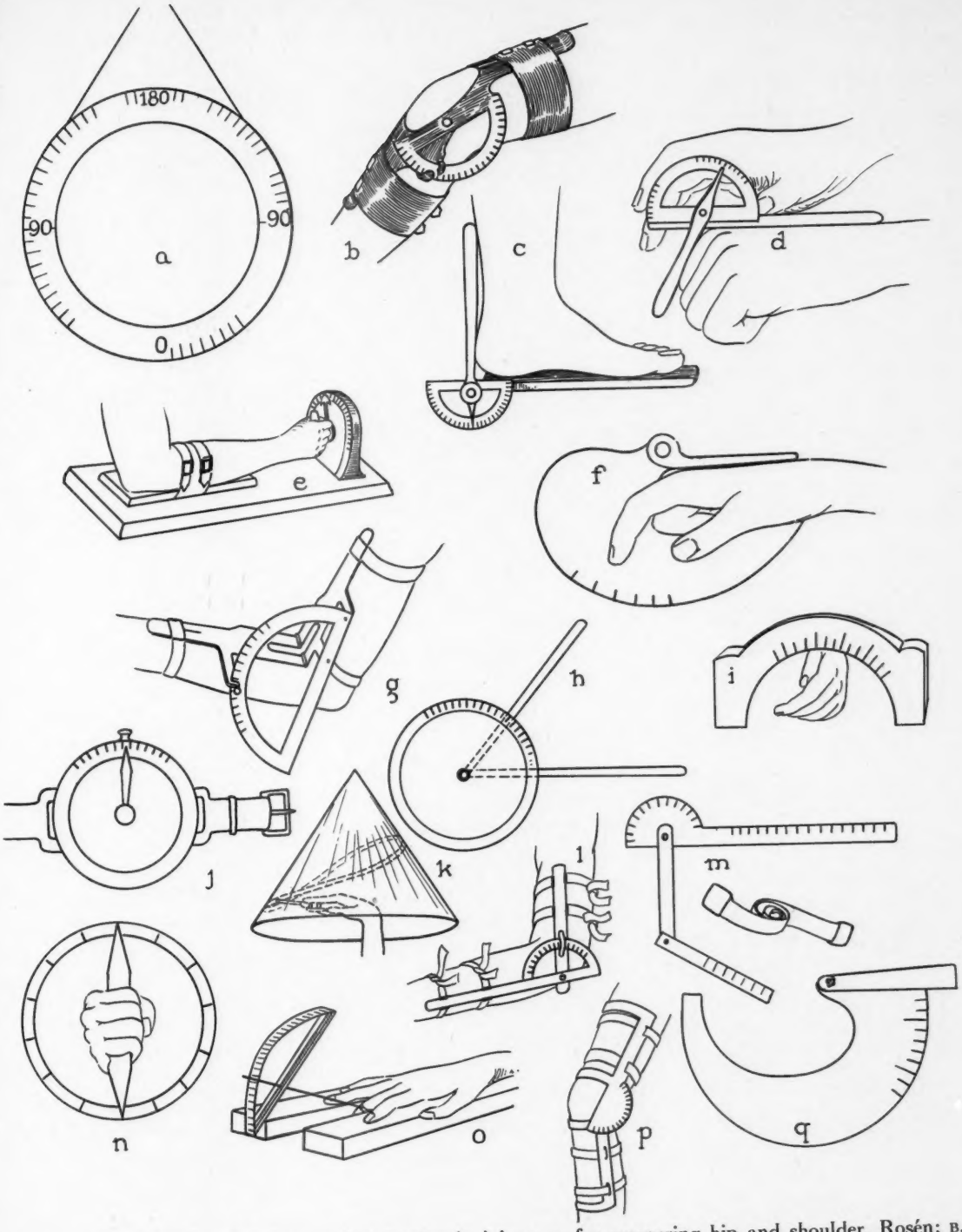

Fig. 3. Instruments used for measuring motion in joints: A, for measuring hip and shoulder, Rosén; B, goniometer for knee; C, fleximeter for ankle and wrist; D, fleximeter for fingers; E, device for measuring supination and pronation, Fox and van Breeman; F, phalango-fleximeter, Rosén; G, fleximeter for elbow joint, Fox and van Breeman; H, fleximeter for elbow joint, Rosén; I, protractor for measuring rotation; W. A. Clark; J, pendulum arthrometer, Fox and van Breeman; K, schematische Kegelprojektion, Mann; L, Winkelanalysator, Filimonoff; M, protractor that can be folded easily, Robinson; N, marking pronation and supination with a pencil, Cleveland; O, fleximeter for fingers, Albee and Gilliland; P, fleximeter for knee, Albee and Gilliland, and Q, protractor scale, Follweiler.

VARIOUS CURRENT METHODS OF RECORDING JOINT MOTION

It is generally accepted that measurements of joint movement and deformity should be recorded and that such records should be absolutely intelligible. These records serve a purpose similar to that of the temperature chart or sphygmographic or electrocardiographic record. Albee and Gilliland, Rosén, Robinson, Fox[7] and others have employed such records to indicate whether recovery was taking place as it should and, if not, as an indication that a change of treatment, or possibly an operation, was necessary. If recovery is not taking place uniformly, this fact is brought out in the series of measurements, and the chart indicates where most attention should be directed. When the surgeon has a large number of patients under his care, it is, of course, impossible for him to remember the condition of each one or his needs and progress; by a system of accurate and clear records, however, it is a simple matter for him to see at a glance just how each one is progressing.

Various methods of recording such measurements are used by the medical profession, ranging from hastily scribbled notes on the patient's history of the deformity or extent of limited motion to elaborate photographing and graphing of degrees of movement on special graph paper:

Photographs. The usual method of recording joint function is to take a picture of the part at the time treatment is begun, to show the extent of movement possible. Photographs are then taken at regular intervals and at the time the patient is dismissed. A comparison of such photographs will not only show the progress of movement in the part, but also the patient's general condition, the amount of atrophy, the degree of deformity, and so forth. This method is very satisfactory but is costly and time-consuming.

Schematographs. This is a comparatively new method of recording movement. The part is placed in front of a white background with lights shining on it from two directions. The outline is then traced out while the part goes through all of its ranges of motion. Tracings can be made at frequent intervals and comparisons made to note the amount of improvement that has taken place. In this method the various movements of the part are recorded easily on one piece of paper. The apparatus used for recording consists essentially of a box, into which is mounted a camera lens, a mirror to reflect the image, and a piece of clear glass which is placed over an opening above the mirror. The image of the part will be seen on this glass and can then be traced on tracing paper. The difficulty with this method is that, unless the recorder has some skill in drawing, the diagrams will not be very accurate.

Graphs. This method is used quite frequently by physicians and technicians in recording the amount of motion and degree of improvement. In order to insure clearness, a key to the graph or some explanation of the curves must be given. (Fig. 2, B and C.)

Simple Recordings. A simplified method of recording used by many is merely to mention in the patient's history at the time of measurement, the part, the movement being measured, and the findings. For example, for the right elbow: flexion to 130 degrees, extension to 180 degrees; range of motion 50 degrees. (Fig. 2, A and D.)

Diagrammatic Drawings. Nutter[10,11] stated: "Greater use should be made of geographic (sic) records in the interest of clearness. Diagrams will make plain what we mean, even though we differ in our terms. These graphic records take very little time to sketch free hand. If actual measurement in degrees of a joint is wanted the sketch is used and the angles are measured." (Fig. 1D, E, F, and G.) Here again, unless the illustrator can make his diagrams quite clear, the records will not be intelligible.

Apparatus. The necessity for treating and recording disabilities sustained in the

World War stimulated the development of a great many instruments for measuring the amplitude of movements in various joints. Nearly as many instruments have been devised as there are joints in the body, among them goniometers for measuring motion in the knee joint, protractors for shoulder joints, fleximeters for elbow, ankle, wrist and finger joints, and special instruments for measuring supination and pronation. These instruments have also been used to measure the amount of angular deformity of a fracture in a roentgenogram, and occasionally they are used in designing braces.

Such instruments vary widely in design. Some are elaborately constructed of metal framework and demand a special technique for accurate use; others are quite simple copper or wooden frames that fit over or about the limb and have a dial from which readings can be made. According to Robinson, the original instrument for measuring joint movement was a protractor so modified that it could be used on all of the extremities. It consisted essentially of two arms, to the end of one of which was attached a protractor scale, the end of the other arm being shaped to a pointer. These arms were connected at the axis of the scale so that the pointer registered on the scale. Instruments and apparatus in present use or that were used formerly are illustrated in Figures 3 and 4.

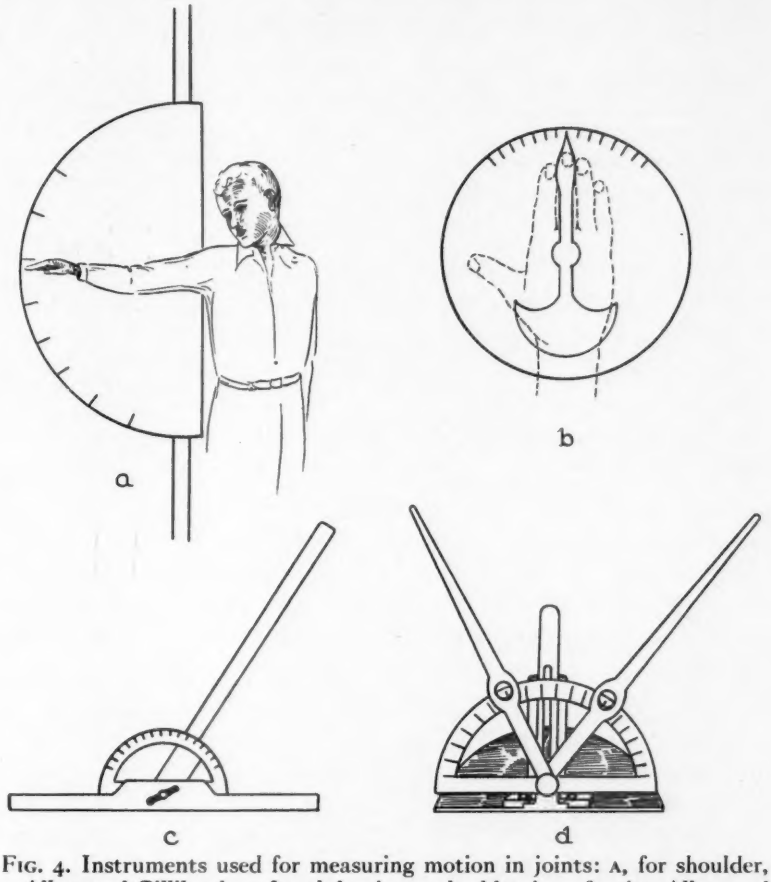

Fig. 4. Instruments used for measuring motion in joints: A, for shoulder, Albee and Gilliland; B, for abduction and adduction of wrist, Albee and Gilliland; C, wood protractor, Krusen, and D, type of protractor used at present at the Mayo Clinic, Krusen.

A NEW SYSTEM OF JOINT MEASUREMENT

The system of measurement now in use at the Mayo Clinic is based on the half circle arc. Movements are measured either from 0 to 180 degrees or from 180 to 0

degrees. Wherever the part stops in its course on the scale (Fig. 4D), the number opposite the part indicates the degree of motion. The number of degrees, as will be seen in the records of this system, indicates the limit of motion on the half circle scale and not the amount of motion. Flexion and extension may be stated as flexion or extension to the number of degrees indicated on the scale.

TABLE II

NORMAL LIMITS OF MOTION

I. Shoulder:
- A. Neutral position: Patient lying, arm extended at side, palm down.
  1. Forward elevation (flexion): 180° to 0°.
  2. Extension: 0° to 180°.
- B. Neutral position: Patient sitting, arm extended at side.
  1. Backward elevation (hyperextension): 180° to 135°.
- C. Neutral position: Patient lying, arm extended at side.
  1. Sideward elevation (abduction): 0° to 180°.
- D. Neutral position: Arm extended sideward, straight with shoulder line, elbow bent at an angle of 90°. The arm is in midposition between inward and outward rotation.
  1. Inward rotation, 180° to 0°.
  2. Outward rotation, 0° to 180°.

II. Elbow joint:
- A. Neutral position: Patient lying with arm extended, palm up.
  1. Flexion, 180° to 45°.
  2. Extension, 45° to 180°.
- B. Rotation in radio-ulnar articulation. Neutral position: Midposition between pronation and supination. Scale to read 90°. Measure with the fingers extended.
  1. Pronation, 180° to 0°.
  2. Supination, 0° to 180°.

III. Wrist joint:
- A. Neutral position: Hand and wrist in midposition between pronation and supination, the wrist straight.
  1. Flexion (palmar flexion), 145° to 30°.
  2. Extension (dorsal flexion), 30° to 145°.
- B. Neutral position: Hand in midposition between adduction and abduction. Scale to read 90°.
  1. Abduction (ulnar flexion) to 165°.
  2. Adduction (radial flexion) to 55°.

IV. Metacarpophalangeal joints (after Clark):
- A. Neutral position: Fingers in extension.
  1. Flexion, to 90°.
  2. Extension, to 180°.
  3. Hyperextension, to 140°.
  4. Abduction (varies for different fingers).

V. Finger joints:
- A. Neutral position. Fingers in extension.
  1. Flexion (proximal joint), to 75°. (distal joint), to 90°.
  2. Extension, either joint, to 180°.
  3. Hyperextension, slight and quite variable.

VI. Thumb:
- A. Neutral position: Thumb alongside the forefingers and extended.
  1. Adduction, to 170°.
  2. Abduction, to 130°.
  3. Extension, to 180°.
  4. Flexion (with wrist), to 90°.
  5. Hyperextension (with abduction), to 110°.

VII. Hip:
- A. Neutral position: Patient lying supine, leg extended.
  1. Forward elevation (flexion) with knee bent, 180° to 60°. With knee straight, 180° to 90°.
  2. Extension, 60° or 90° to 180°.
- B. Neutral position: Patient lying prone, leg extended.
  1. Backward elevation (extension or hyperextension), 180° to 135°.
- C. Neutral position: Patient lying supine, leg extended.

  Sideward elevation (abduction), 0° to 45°.

VIII. Knee:
- A. Neutral position: Patient lying prone, leg extended, knee straight.
  1. Flexion, 180° to 45°.
  2. Extension, 45° to 180°.

IX. Ankle:
- A. Neutral position: Patient lying supine, the outer border of the foot held at 90° with the leg out in midposition between inversion and eversion.
  1. Flexion (dorsal flexion), from 155° to 60°.
  2. Extension (plantar flexion), from 60° to 155°.

X. Foot:
- A. Neutral position. Cannot be defined; measurements vary for every part.
  1. Eversion } Subastragalar
  2. Inversion }
  3. Adduction } Mediotarsal
  4. Abduction }
  5. Flexion } Metatarsophalangeal
  6. Extension }

The zero end of this arc is toward the head and median line of the body. As movement approaches the head, the angle of the joint becomes smaller and reading on

the scale will be less. Motion away from the head will increase the angle, and the reading on the scale will be higher. The same is true when measuring toward and away from the body; the angle of motion will decrease as it approaches the median line and increase as it moves away from the median line. In rotation, including pronation and supination, the zero end is toward the median line of the body. Extension is movement toward 180 degrees, flexion toward 0 degrees, and the half circle arc in the anteroposterior plane. Hyperextension is movement toward the head, and measurement will read from 180 to 0 degrees. Measurement of adduction will read toward 0 degrees and of abduction toward 180 degrees. These measurements are made with the arm in the prone position in the lateral plane. Internal rotation is toward 0 degrees and external rotation toward 180 degrees on the anterior half circle arc in the transverse plane.

Neutral Position. The neutral position is that position of the joint from which measurements shall proceed. From this position the joint will begin on its course of movement. Readings on the scale may begin either from 0, 90, or 180 degrees. The normal limits of motion for each joint as here given can be considered only as approximate. (Table II.)

A SIMPLIFIED INSTRUMENT FOR JOINT MEASUREMENT

An instrument has been devised at the clinic by which any joint in the body can be measured. (Fig. 4D.) With only a moderate amount of care in placing it and in taking the reading, as great accuracy is attained as with a much more complicated apparatus. This instrument consists essentially of a stand which is joined to a higher upright. A protractor scale is attached to this upright in such a manner that it can be moved upward and downward in the vertical plane; or the stand can be detached and the protractor can be used in the horizontal plane. Also attached to the upright are two long arms. These move along the scale and facilitate movement and reading of joint motion. The reading is taken by placing the instrument so that its little axis pin is over one end of the axis of motion of the joint under observation, the upper arm corresponding as nearly as possible to the long axis of the bone above the joint and the other arm, being in the same relationship to the bone or bones below; the upper arm of the instrument is held firmly in position either by hand or by straps, while the lower bone member of the joint is moved in one direction to its fullest extent. The reading is then taken on the scale. Following this, motion is made in the opposite direction and the reading is taken again. Thus there is determined the number of degrees of motion allowed and the relationship of the extreme positions to the axis of the proximal bone.

SUMMARY AND CONCLUSIONS

There is definite need for a systematic and uniform method of measuring and recording joint motion, which is clearly shown by records in medicolegal cases, of industrial compensation boards and by statements of physicians.

As a result of recording measurements, there is a markedly beneficial psychologic effect when the patient can follow his progress graphically. Accurate measurements, however, necessitate a uniform system of measuring joint motion. Various current systems are discussed and instruments used for measuring joint motion are illustrated.

The lack of uniformity in records, the great number of instruments used for measurement and the diversity of terms used in describing motion have caused much confusion. A system of measurement is therefore presented which defines the movements of nearly all the joints of the body, and an instrument that will measure joint motion accurately is described. Approximate normal ranges of motion for the joints discussed are also given. This system is based on the following: Measurements of movements made toward the head in the

anteroposterior planes will read toward o degrees; measurements of movements away from the head will read toward 180 degrees. In the lateral plane, measurements of movement toward the body will read toward o degrees and measurement of motion away from the body will read toward 180 degrees. All measurements will be made on the half circle scale from o to 180 degrees.

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RHYTHMIC SURGERY

ARRANGEMENT OF THE OPERATING ROOM

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Summit Medical Group

SUMMIT, NEW JERSEY

ONE cannot approach the subject of motion economy in any field without careful planning of the work place, to the end that the principles of "work simplification" can be applied. The present operating room setup* demonstrates that there has been little if any change in the past thirty years, that is, during those years in which the science of motion study has developed. The arrangement of the instrument and supply tables, as shown in our survey, cannot be adapted to the fundamental principles of motion economy. An outstanding fault is to have the supply tables to the side or in back of the instrument nurse and not to have the tools always in front of the one handling them. Our micromotion studies have convinced us that a great number of awkward and inefficient motions are the direct result of this traditional setup.

The operating theater itself should be ample in size—there is a tendency toward making this room too small. We believe in having a separate room adjoining the operating theater for the administration of the anesthetic, in order that the patient may be moved into the already prepared work shop, rather than having the work shop assembled about the operating table. Naturally, advantage must be taken of the latest developments in the lighting field. Operating tables have certainly engaged the interest of surgeons, and this piece of surgical furniture has been brought to the highest degree of efficiency. While the operating table has received so much consideration, the instrument and supply tables have been sadly neglected. Radical changes in these important facilities seem to be necessary to provide for: (a) prelocation of instruments and supplies within the normal grasping area; (b) the use of both hands; (c) the ability of the whole team to be at all times facing the field of operation; and (d) the fatigue factor.

Industry has found that the circular assembly setup answers these requirements. The tables described in our previous article[1] and used by us for the past year are making it possible to apply with increasing satisfaction the science of motion economy to our surgical work.

The division of the instrument and supply tables into two units is the crux of the whole problem. This dual arrangement encourages the use of both hands. It furnishes a place for the instruments and supplies which we see so often piled in disorder on the chest of a patient during laparotomy, where they too frequently slide off to the floor. In any surgical procedure, there should be "trays to the right of them, trays to the left of them."

We have been particularly interested in an article by W. H. Ogilvie.[2] We note that his plan of the field of work suggests some of the points touched on in this article. However, we are frank to criticize his arrangement of planned work. Certainly such a setup can in no way permit motion economy. Look at the reach for the dump for used materials. From his diagram itself, one can see that practically all of his work is done in the maximum grasping area, with no provision for two-handed activity. Mr. Ogilvie may be entirely satisfied with the right sided arrangement of his own

* In the past year we have made a survey of 500 operating rooms throughout the United States, and they all depend upon the Mayo instrument stand, plus instrument and supply tables placed to the side or behind the instrument nurse.

tools, but is it always possible for him to secure a left handed assistant?

We believe that the two-table equal duty

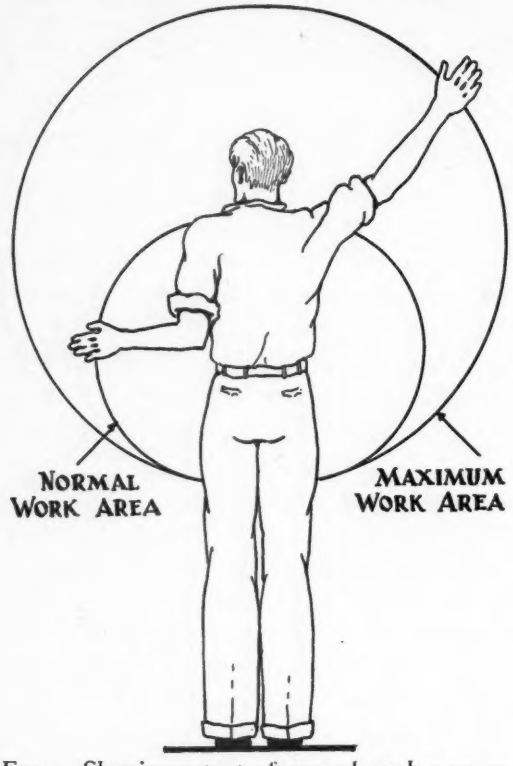

Fig. 1. Showing extent of normal work area as compared with maximum work area.

arrangement of instruments and supplies has value aside from these considerations. In the case of many hospitals, they answer a dual problem: the problem of the surgical training of undergraduate nurses and the necessity for a thoroughly experienced instrument nurse as an integral part of any operating team. While it is imperative for undergraduate nurses to have a period of training at the operating table, it is not safe for the patient nor satisfactory to the surgeon to have a student nurse, possibly her first experience in assisting, in sole charge of the armamentarium during an operation. Hospitals say they cannot afford always to have a graduate nurse scrubbed up. Economy should not interfere with an ironclad rule that no major operative procedure should be carried out unless a graduate instrument nurse is actually attending to the operation. With this two-table arrangement, the student nurse can preside over one table and be watched over by the graduate presiding at the other table. The student can then watch and

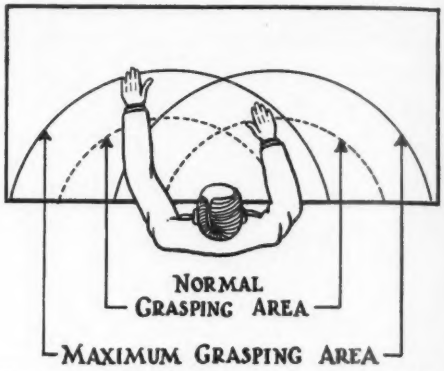

Fig. 2.—Normal and maximum grasping areas.

learn without being placed in a position of terrible responsibility without due preparation and experience.

The instrument and supply tables, the surgical work bench, consist of two similar units, one having narrower ends, due to the limited space between the ensiform cartilage and the neck, the location in which this table is generally used. In work on any part of the body, the major supplies are placed to the master hand of the surgeon, while lesser space is needed for his opposite hand. The tops are made in the arc which corresponds to the normal grasping area of a person standing or sitting in the center of the arc. There is a central pedestal and the leaves of the table extend over the operating table. A raising and lowering device permits adjustment to the proper height. It is desirable to have the instrument trays as nearly as possible at the same level as the wound. The table tops, extending over the patient, permit the placing of instruments and supplies thereon within the normal grasping area of both the surgeon and his first assistant. We have found it much more convenient to have the wash basin incorporated in the table itself, and this eliminates a piece of furniture.

Prelocation of instruments and supplies is essential to any progress in motion economy. Before starting an operation everything that is to be used should be placed in

a definite and fixed position. This will aid the surgical team in "habit formation," permitting development of automaticity. It cannot be emphasized too strongly that it is to the surgeon's advantage to be able to perform his operation with the least possible exertion. It certainly adds to strain to have the materials and tools scattered over the work place in a disorderly fashion, so that the surgeon must exert mental effort searching for the tool he needs. A place for everything and everything in its place saves time and effort. Arranging instruments and supplies properly enables the operator to perform his job in the proper sequence at a rapid pace and with a minimum of effort. Since the eye directs the hand in reaching for an object, the eye must be taken away from the operation itself. However, if the tools are prelocated in a definite place, and if they are always grasped at this definite point, the hand will automatically fall on the right instrument without the assistance of the eye.

Consideration must here be given to the order in which the instruments are to be used, to the end that the first used instrument, e.g. the knives, should be nearest to hand. Working outward from this point, the instruments should be placed in the sequence in which they are ordinarily needed. This prelocation of tools is to be used in the case of the commonly employed instruments, those used in the approach to the pathology, "the front line tools,"[2] such as knives, hemostats, scissors, thumb forceps and Kelly clamps. The less common instruments, those to be used at only one stage in the operation, or the multiple instruments[2] are kept in a definite prelocation by the instrument nurse along the line of her grasping area. It is for these instruments that we generally use manual signals, as they are passed directly from the instrument nurse to the hand of the surgeon or the first assistant. We have found that this results in greater time saving than having the instrument nurse pass all of the instruments.

The instruments should be prelocated within the normal grasping area. It will be noticed that the normal grasping area makes a circular arc about the body of the worker with the arms hanging loosely at the side. Thus a circular assembly setup is required if we are to avoid using the maximum grasping area, which in itself causes awkward and tiresome movements. Having tools in a straight line in front of the worker forces him to reach further and further outward to grasp them, this also running into the maximum grasping area.

In this rearranged operating room setup, we have been able to have the instruments and supplies used by the surgeon in his normal grasping area, and to apply the same principle to each member of the team, the first assistant surgeon and the instrument nurses. Each has his or her instruments and supplies within his or her individual grasping area and all are so coördinated that there is no occasion for anyone to have an extended reach or for twisting or turning the body about in carrying out activities. The handles of the instruments should be along the line which represents the arc of this grasping area. The handles should always be found in exactly the same position (the duty of the instrument nurse), and some device should be invented which will raise the handles above the level of the table. (We are working on this problem now.) The grasping of an instrument lying on a flat surface is more difficult than if the handle is elevated on the principles of the new type of desk pen, which enables one to pick up the pen in just the position in which it is to be used. We should be able to grasp instruments in the position in which we are to use them. This saves repositioning after grasp. In industry, this is called "prepositioning." Having the handles extend over the edge of the table is not satisfactory.

For the guidance of operating room supervisors, some method must be provided to enable them to have the instruments prelocated with exactness. This

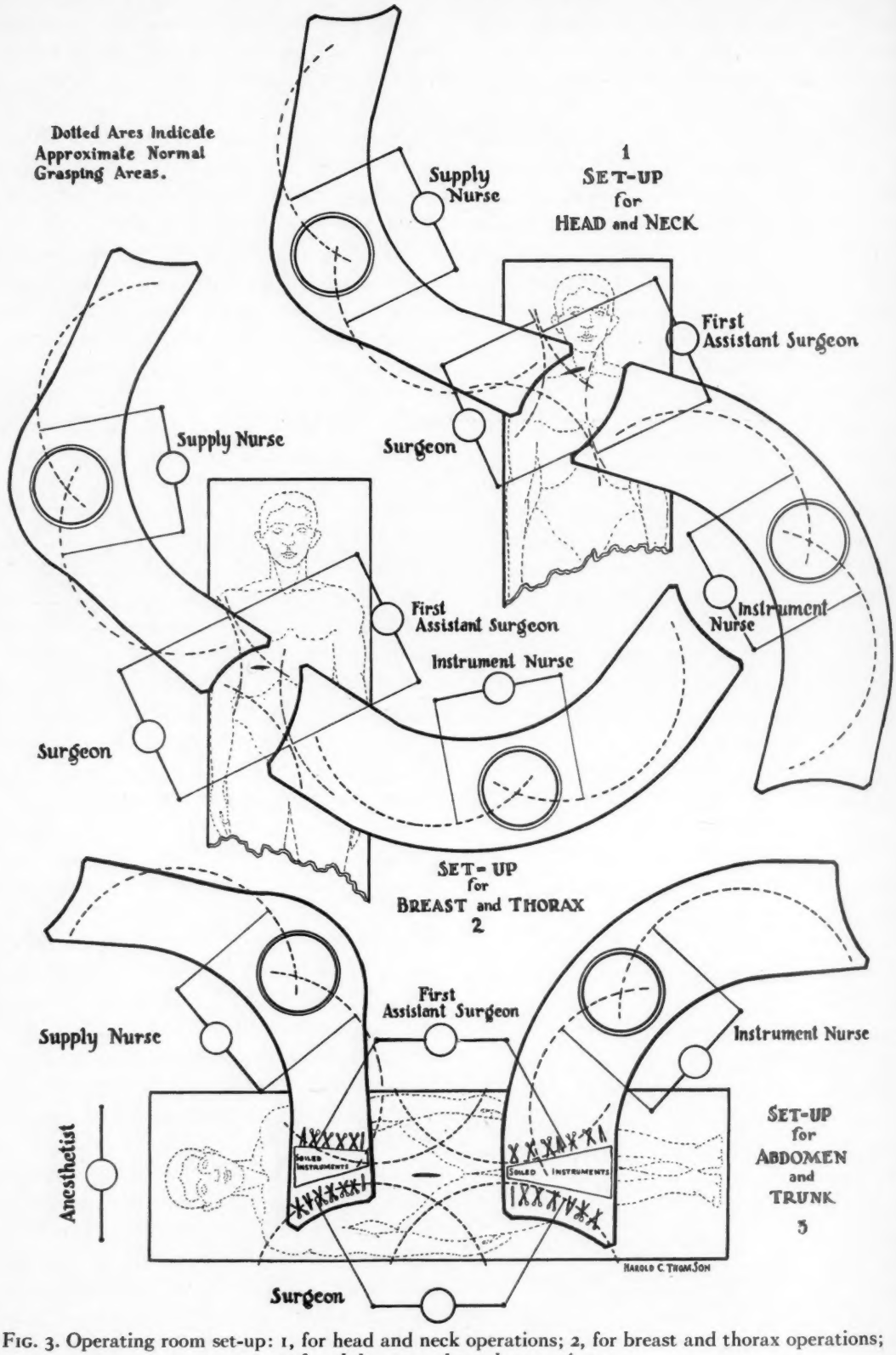

Fig. 3. Operating room set-up: 1, for head and neck operations; 2, for breast and thorax operations; 3, for abdomen and trunk operations.

should imply possibly the use of photography or as has been suggested by Dr. Parry of Asbury Park, an *x*-ray negative showing the instruments in their proper position on the table.

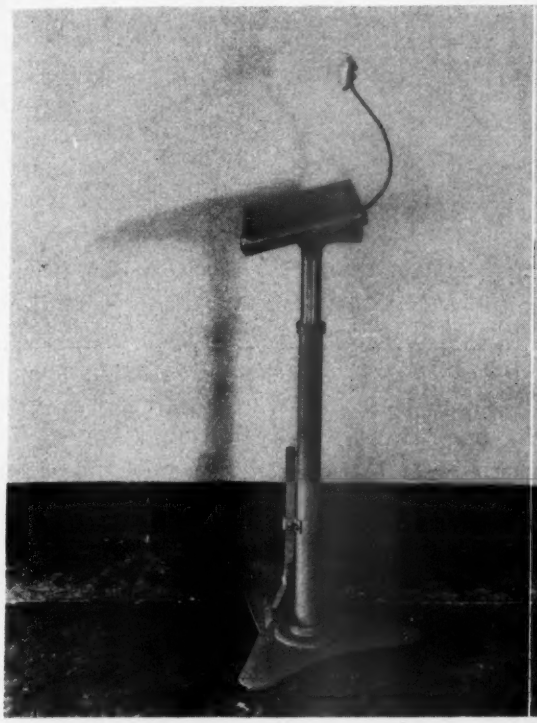

Fig. 4. Surgeon's stool.

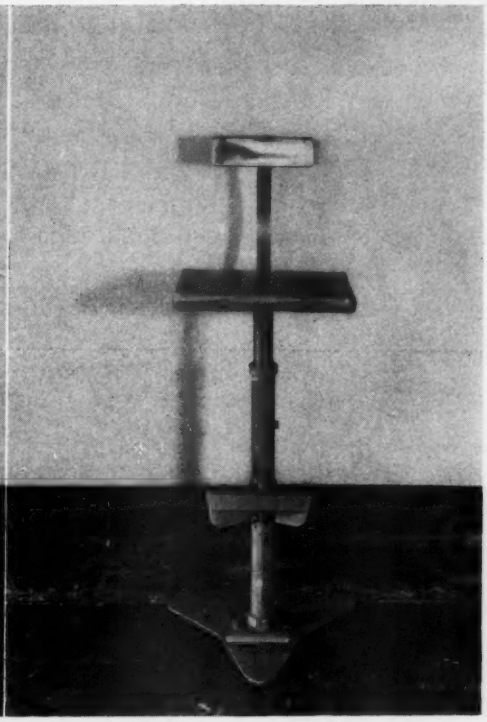

Fig. 5. Nurse's stool.

A second principle of work simplification is the use of both hands profitably and synchronously. It is surprising to discover how many people have only one hand for doing things. The off hand does not seem to do much but hold. The use of both hands in this sense does not mean full ambidexterity, for it is a very simple matter to learn how to use hemostats, scissors and the like with either hand. Certainly if both hands are profitably engaged at the same time, it will not take as long to do a piece of work as with one hand working alone. It is much easier to develop rhythm if both hands are going through balanced movements at the same time, than if one hand is working by itself. Slow motion study of our movies proves this point very clearly. If we make an operation chart of both the right and left hands from such study, we can develop ways to get the lazy hand to work, and we will have made progress toward two-hand consciousness. With the dual instrument tables, two-hand action is encouraged. If one finds an instrument or sponge ready to hand, it is natural to pick it up and make use of it with that hand. It certainly does not promote pleasing rhythm to reach across in front of the body to get something or to put something down. These motions involve both maximum reach and turning of the body. The dual setup described gives full play to the training of the off hand and in practical use we have derived much satisfaction from it.

An operation should have the continuous undivided attention of the whole operating team. It should not be necessary for any of them to turn around at all. We have a moving picture film taken of an operation with the common setup, which demonstrates that the surgeon could have seen the back of his chief instrument nurse eight times in seven minutes. As one studies these matters and becomes motion conscious, many of these defects can be detected by simple observation.

No work place gives out fully the principles of work simplification unless it meets the problems of fatigue. This fatigue factor has not received the consideration it merits. Too often have we seen exhausted operating teams. No member of the team can afford to be exhausted during a surgical maneuver. Operating room supervisors welcome the thought of lessening fatigue, footache and backache, in the case of their nurses. Careful planning can do much to ease this strain. The height of the operating table should be so placed as to be raised or lowered at will. Stools or rests of proper design should be provided to permit good posture and to allow the individual the choice of sitting or standing without turning away from the work place. Long continued standing or sitting is likewise exhausting, and the ability to change from the one position to the other is restful. So important is this, the ability to stand or sit, from the point of view of health, that some states have laws requiring that the work place be so arranged.

When high chairs or stools are used, they must be provided with a foot rest. The absence of a foot rest forces the worker to hook the heel of his shoe over a rung of the chair or let his feet dangle in the air. Either position is uncomfortable. We have devised chairs and stools to meet these special needs. The photographs give a general idea of the ones we are using. These stools and chairs are fitted with a device to raise or lower the seat. A spring arrangement in the pedestal, controlled by a foot lever, makes it possible to have the chair at the proper level. It does not require the services of another helper, nor does it involve any use of the sterilized hands. The back rest is similar to that used in the common stenographer's chair.

Seating of the operating team is only practical when the circular assembly setup is used as outlined, because here alone we eliminate the necessity for any maximum grasp or turning away from the field of operation. Let us increase our efficiency of thought and action by eliminating fatigue as much as possible.

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MALIGNANT TUMORS OF THE TESTICLE

A REVIEW OF EIGHTY-THREE CASES

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MALIGNANT tumors of the testicle are rather rare as compared with new growths in other parts of the body. Simpson[1] states that they constitute approximately 0.5 per cent of all malignant tumors in the male and only 0.063 per cent of all general hospital admissions. MacKenzie[2] reports only twenty-seven cases of testicular tumors in 307,174 admissions at the Royal Victoria Hospital. At the Mayo Clinic the frequency is said to be one in 6,000 general admissions. The files of the Cleveland Clinic contain records of eighty-three cases of malignant tumors of the testicle. These include twenty-three cases previously reported by Higgins.[3]

The pathologic classification of tumors of the testis has always been a subject of controversy and still is in confusion. Langhans'[4] work in 1887 marked a distinct epoch in our knowledge of testicular tumors. He recognized microscopically the teratomatous and carcinomatous nature of these growths and classified them on a structural basis.

In 1911 Ewing,[5] after reviewing the literature and carefully studying a series of cases, concluded that all tumors of the testicle were of teratomatous nature. This conclusion was disputed by Chevassu[6] who believed that the majority of malignant tumors of the testicle were solid tumors arising from the epithelium of the seminiferous tubules, and he applied to them the term "seminome." Ewing[5] contended that the seminoma of Chevassu is not distinct from the malignant embryoma, but that it is an embryoma or teratoid tumor in which there is a one-sided cellular development resulting in a tumor made up of homologous cells with lymphoid stroma. These two theories regarding the origin of malignant testicular tumors have prevailed; Ewing's theory has been upheld by Wilms,[7] Martland and O'Crowley,[8] Cairns,[9] and others, while Chevassu's theory has been supported by Eisendrath and Schultz,[10] Thalhimer and Geist,[11] and many others.

At the present time, the accepted classification seems to be the division of testicular neoplasms into the homologous and the heterologous types of tumor. The former are comprised mainly of the so-called pure monocellular seminomata and the sarcomata. The heterologous tumors are of two kinds: (1) the mixed tumors of adult tissue, the so-called organized embryomata, dermoid cysts, and adult teratomata; and (2) the embryonal tumors, a group composed of the chorionepitheliomata, embryonal adenocarcinomata, the sarcomatous mixed tumors, and the embryonal carcinomata, depending upon the predominance of trophoblastic, hypoblastic, mesoblastic, or epiblastic elements respectively.

Pathology: Most malignant tumors of the testicle may be classified into one of two groups: (1) teratomata or heterologous tumors, and (2) seminomata or homologous tumors.

Teratomata comprise the majority of the malignant tumors of the testicle. They are mixed tumors which contain the derivatives of the three germinal layers. Adami[12] best describes this growth by saying that it arises from a totipotent cell which has the power of giving rise to every order of cell in the body. An adult teratoma is one in which the tissues are fully differentiated and arrange themselves in an orderly fashion. These are not highly malignant, run a more

prolonged clinical course, and distant metastases are less frequent. They constitute only 5 to 10 per cent of all teratomata.

The embryonal teratoma, as the name implies, is one in which the tissues are less differentiated. The most common tumor in this group is the so-called embryonal carcinoma in which there is a predominance of the large, round, or polyhedral cells with a vesicular hyperchromatic nucleus. Grossly, it is soft, rapidly growing, and often shows areas of necrosis, hemorrhage, or suppuration. It is very malignant and metastasizes early. Usually the presence of heterologous elements indicates the teratomatous nature of the tumor; however, at times it is difficult to differentiate it from the homologous type.

The seminoma or spheroidal cell tumor is large, firm, pearly gray in color, and medullary in character. Microscopically it is composed of large spheroidal or ovoid cells with deeply staining nuclei and granular cytoplasm.

In the literature, great variation is found regarding the incidence of the different types of testicular tumors, this being largely due to various methods of classification employed by different authors. Of the eighty-three cases which we reviewed, eleven were reported as seminomata, forty-seven as teratomata of which twenty-seven were listed as embryonal carcinomata, eleven as sarcomata, and in fourteen cases the type was not specified. This grouping is in all probability somewhat inaccurate as the patients in this series were seen and treated over a period of the past thirty-five years and in the majority of the earlier cases we were unable to obtain a specimen or slide for rediagnosis. The low percentage of seminomata and the high incidence of sarcomata in this series is explainable, we believe, by the fact that many of the former were miscalled sarcomata, especially among the earlier cases.

Age Incidence. Malignant tumors of the testicle appear most frequently during the age of greatest sexual activity, that is, between the ages of 20 and 50 years, although no age is exempt. In this series, 87.5 per cent of the cases occurred within this age limit. According to Kutzmann, Gibson and Perkins,[13] tumors of the testicle are of comparatively rare occurrence in children, and when they do occur it is chiefly in early infancy, usually during the first year of life. Roche[14] states that 84 per cent of testicular dermoids occur during the first year of life and according to Simpson[1] the greatest incidence of teratoma is between 20 and 30 years, while that of seminoma is between 30 and 40 years. Eisendrath and Schultz[10] analyzed nine cases of embryonal carcinoma in which the average age of the patients was 29 years, and six cases of seminoma in which the average age was 41 years. In our series (Table 1) the average age of the patients with seminoma was 39 years and of those with teratoma 34 years. The youngest patient in the group was 20 years of age and the oldest 64 years.

ETIOLOGY

The etiology of malignant tumors of the testicle, like that of all malignant tumors, remains unsolved. Most writers agree that heredity plays no part in this disease. In many cases the patient gives a history of trauma which some authors consider an important etiologic factor while others believe this frequently is merely the incident that causes the patient to note an enlargement of the testicle but that the enlargement was already present. The fact that trauma might initiate the growth cannot be denied but is difficult to prove. It is known that constant and prolonged irritation may promote the production of a malignant growth. The presence of a preëxisting tumor of the testicle cannot be excluded as a possible cause and such a tumor may be stimulated by trauma to more rapid growth. In Dean's[15] series, fourteen of the 124 patients, or 11 per cent, had observed the enlargement after trauma to the testicle. Kober[16] reports that 28 per cent of a series of 114 patients gave a history of previous trauma, Stelle[17] gives

13.3 per cent as the incidence of trauma in his series, and Rea,[18] reviewing seventy-six cases, reports that twenty-nine, or 38 per cent of his patients, had experienced definite trauma, three had hydrocele, and four coëxisting hernia. In our series sixteen, or 19.2 per cent, of the patients gave a history of trauma and in three of these the injury had occurred twenty years or more before the development of the tumor. Fifteen, or 18.1 per cent, of the patients had a hydrocele as well as a tumor, and three had a coëxisting hernia.

Testicular tumors are said to occur more frequently in undescended than in normally descended testicles. Simpson,[1] quoting Marshall, Hempel, and Howard, reported the incidence of cryptorchidism among 7,119,800 normal men to be 0.12 per cent. The War Department medical records for the World War lists 3.1 cases of ectopy for every 1,000 men examined. Hinman[19] collected 728 cases of testicular tumors variously reported and found that eighty-two, or 11.2 per cent, occurred in undescended testes. He also found that in 3,646 cases of undescended testes variously collected, there were only eight instances of malignancy. Odiorne and Simmons[20] report a series of fifty-four testicular tumors of which 11 per cent were incompletely descended and in Dean's[15] series of 124 cases, 13 per cent were cryptorchid. In our series of eighty-three cases, seven patients, or 8.43 per cent, had cryptorchidism. Thus the incidence of undescended testis among patients with testicular neoplasms appears to be thirty to one hundred times as great as that among normal individuals. This increased incidence is believed by many to be due to the fact that undescended testicles are more subject to repeated traumatism.

Reports in the literature vary as to the predominance of tumors in the right or left testicle but all agree that bilateral testicular tumors are quite rare. In Cunningham's[21] series, thirty-four of the tumors were found to involve the right testicle, twenty-five the left, and three were bilateral. In Dean's[15] series 55 per cent involved the right testicle and 47 per cent the left. Rea[18] reports that the right testicle was involved thirty-four times and the left twenty-two times in his series. In our cases forty-nine involved the right side, twenty-nine the left, two cases were bilateral, and in three histories the side was not specified. In 1932 Peirson[22] collected from the literature forty-six cases of bilateral malignant tumors of the testis and added one additional case.

SYMPTOMS

There are no pathognomic signs or symptoms of a malignant tumor of the testicle. The first symptom ordinarily noted is an increase in the size of the testicle, this usually being painless and accompanied by a feeling of weight or fullness in the scrotum. In 92 per cent of the 124 cases reported by Dean,[15] increase in the size of the testicle was the first sign. Loss of weight occurred less frequently but was present in 41 per cent of Young's[23] and 57 per cent of Dean's[15] cases. In 83 per cent of the cases in our series, enlargement of the testicle was the chief complaint. Pain and tenderness were present in many cases but were strikingly absent in others. In Tanner's[24] series, 52 per cent of the patients complained of pain, while among Dean's[15] cases only a few patients suffered from this symptom. Abdominal cramps, pain in the back, indigestion, anorexia, weakness, and respiratory symptoms are late manifestations and usually indicate the presence of metastases. The course of the disease is dependent upon the type of tumor and the extent of metastasis.

DIAGNOSIS

The rapid progress and unfavorable prognosis of most testicular tumors make early diagnosis imperative if satisfactory results are to be obtained.

A man between the ages of 20 and 50, presenting himself with a testicular enlargement with or without a history of previous trauma or infection, should be

examined with the possibility of malignant disease in mind. Inspection usually discloses unilateral enlargement of the scrotum without signs of inflammation. Generally there is no apparent retraction or shortening of the penis as is so frequently observed in hydrocele. The tumor cannot be visualized by transillumination unless some portion shows cystic degeneration.

As a rule, palpation reveals the testicle to be smooth, ovoid, and symmetrically enlarged. Occasionally, nodules or areas of softness may be felt. The tumor is freely movable within the scrotum and manipulation is not accompanied by pain. Large veins may cover the mass and be seen through the skin. The spermatic cord may be normal or in late cases may be enlarged and infiltrated by tumor tissue. The epididymitis is usually palpable and affords a valuable diagnostic aid, as one can then be certain that the enlargement involves the testis proper. However, at times it is flattened out and spread over the mass so that it cannot be made out.

In making a differential diagnosis, gumma, tuberculosis, hydrocele, hematocele, and orchitis must be considered.

A gumma more nearly simulates tumor than any other testicular lesion. Careful questioning may elicit the history of a primary luetic lesion, but a determination of the Wassermann reaction should be made in all cases of testicular enlargement. If doubt still exists as to the character of the tumor, the administration of antiluetic therapy for one or two weeks will usually suffice to differentiate the conditions. It should be borne in mind, however, that lues and a malignant tumor of the testicle may coëxist, so undue dependence must not be placed upon a positive Wassermann reaction in a case in which the tumor does not respond to antiluetic therapy. In one of our cases a swelling of the right testicle developed in a 34 year old man who was known to have lues. This did not decrease in size following antiluetic therapy. The pathologic diagnosis of the tissue removed at operation was embryonal carcinoma. Metastasis later developed to the retroperitoneal lymph nodes on the right side.

A careful investigation into the personal and familial histories of the patient may often be of value in determining whether the condition is due to tuberculosis. In a tuberculous infection, the epididymis is the primary seat of the disease and only in very late stages is the testis proper involved. The epididymis is nodular, the vas deferens frequently bead-like, and the seminal vesicles and prostate are often involved. If the lesion extends to the skin of the scrotum, ulceration and persistent sinus formation usually follow. A roentgenogram of the lungs may also demonstrate the presence of an active or latent tuberculous lesion there. As for the clinical course of tuberculosis, it may be more rapid than that of a malignant growth, pain is more frequently present, and an elevation of temperature may be noted.

It must be borne in mind that a hydrocele and a malignant tumor of the testicle may coexist. This combination of diseases was found in 15 or 18.1 per cent of the cases in our series. Transillumination should always be employed in making a diagnosis of hydrocele. Because of the frequent coexistence of these conditions, all hydroceles should be aspirated and the testicle carefully palpated after the tapping to determine the presence or absence of a tumor.

In the differential diagnosis between hematocele and tumor of the testicle, it is important to learn whether there is a history of trauma. The swelling of a hematocele is usually uniform and firm, and seldom is one able to transilluminate the scrotum or to produce fluctuation. Cunningham[25] states that "needle puncture in suspected hematocele is useless and dangerous; blood need not come from a hematocele, and the needle point may disseminate new growth." One's diagnostic ability may be taxed to the utmost to differentiate a hematocele of long duration in which solidification has taken place from

a malignant tumor of the testicle. Tanner[24] states that the "tunica vaginalis can be palpated on the surface of a scrotal tumor and that is not true in hematocele, in which also the epididymis cannot be felt between the fingers, as it is hidden within the hematocele."

In orchitis there is often a history of recent trauma and physical examination usually reveals a painful, inflamed, swollen testicle.

Diagnostic methods of the past, which have been largely a process of elimination, have led to many incorrect conclusions. In many other instances, uncertainty of diagnosis in neoplastic disease of the testis has resulted in the loss of valuable time before the institution of treatment. Since the discovery that sex hormone of the anterior hypophysis is present in the urine of patients with malignant testicular tumors, a correct diagnosis may be made more promptly. The appearance of this sex hormone of the anterior hypophysis or prolan A in patients with malignant testicular tumors was first observed by Zondek[26] in 1929. Ferguson[27] states that prolan A is not found in the urine of a normal, healthy man. He believes that the hormone disappears from the urine within seven to ten days after birth and does not again reappear except when some pathology is present. Branch[28] examined the urine of 500 men and found that no hormone was present except in two cases of teratoma of the testis. However, Katzman and Doisy[29] have stated that a small amount of prolan A is found in the urine of normal men between puberty and the climacteric but in a quantity very much smaller than that in the urine of patients suffering from teratomata.

Ferguson[30] has studied in great detail the excretion of this gonadotropic hormone in men with malignant testicular tumors, using in all his investigations a quantitative method of determining the presence of the hormone. He studied 100 cases of benign lesions of the testis and in no case was the excretion of prolan A more than 100 mouse units per liter of urine. He then studied 117 cases of untreated teratoid tumors, except the adult cystic types, and in each case there was an excretion of prolan A in excess of 500 mouse units per liter of urine. In another article Ferguson[31] reports the following findings, after carrying out a quantitative hormone determination in 37 cases of testicular tumors:

Structure	Cases	Limits of Initial Excretion of Prolan A in Mouse Units per Liter of Urine
Embryonal adenocarcinoma	7	10,000–40,000
Embryonal carcinoma with lymphoid stroma	15	2,000–10,000
Seminoma	10	400–2,000
Adult teratoma	5	50–500

Ferguson[27] concludes that the hormone output increases in proportion to the embryonal character of the tumor and decreases as the tumor approaches the adult type. He also states that the excretion of prolan A increases as metastases become more extensive.

Hinman[32] states that his experience with the hormone tests seems to show that neither the sarcomata nor the pure monocellular seminomata cause the excretion of a gonadotropic hormone. In our series, a qualitative Friedman test was carried out on four of the patients seen recently. Two tests gave definitely positive reactions, one being in a case of embryonal carcinoma and the other in a case of bilateral reticulum cell sarcoma. A third test which was performed on a patient with a well differentiated teratoma gave entirely negative results, while the fourth test on a man with a seminoma was reported negative, but showed three plus congestion of the uterus and one plus swelling of the uterus. The diagnosis in each case was confirmed by a careful study of the pathologic specimen.

It was anticipated that the tumor which caused the excretion of the greatest amount

of prolan A would be most sensitive to irradiation but this has not proved to be true. However, a quantitative estimation of this hormone does afford a method of determining the radiosensitivity of a testicular tumor. The method of doing this is stated by Henline[33] as follows: "The original amount of prolan A excreted is first determined. The tumor, groin, and lower abdomen are then exposed to a full skin erythema dose of high voltage *x*-ray. If, following this treatment, the hormone output drops sharply, one may conclude that the tumor is radiosensitive and the prognosis is more favorable."

Ferguson[30] states that the hormone is absent in the urine as early as seven days after an operation for testicular tumor providing all tumor tissue has been removed. He also noted that in recurrent cases there was an increased output of prolan A in the urine from two weeks to two months before the recurrences could be demonstrated clinically.

The absence of pain in the early stages of the tumor is unfortunate. Patients usually consult a physician for pain; hence patients with tumors of the testicle often fail to seek medical advice until months after the onset of the tumorous growth or until they are annoyed by other symptoms produced by metastatic lesions. In our series, the average length of time which elapsed between the discovery of the swelling of the testicle and the medical consultation was 16.7 months, the shortest duration of symptoms being one month, and the longest five years. Dean,[15] in his series of 124 cases, found the average duration of symptoms before a physician was consulted to be eighteen months and in 45 per cent, the duration was more than one year.

In many cases, clinical evidence of metastasis is present before treatment is sought. Among the eighty-three cases included in our series, twenty-seven or 32.5 per cent showed clinical evidence of metastasis when first seen. Dean[34] reports sixty-three cases in 49 per cent of which metastatic lesions were present when the patient was first examined. In 84 per cent the metastases had occurred to the spermatic cord and lumbar nodes and in 16 per cent to the lungs. Metastasis often occurs quite early in the disease and may take place by either one or both of two routes, (1) the lymphatics or (2) the blood vessels. Simons[35] states that there is no superficial lymphatic route from the testicle to the superficial inguinal glands; thus metastasis does not occur to these glands unless the skin of the scrotum is involved.

The lymphatics of the testicle are numerous and commence chiefly in the lymph spaces between the seminiferous tubules. According to the work of Jamieson and Dobson,[36] the lymphatics of the testicle unite with the lymphatics of the epididymis and follow the spermatic cord to the ureter and then enter the primary lumbar nodes surrounding the aorta and vena cava. These glands extend from the beginning of the common iliac artery to the renal vessels. The commonest primary distribution for the right side is between the aorta and vena cava and upon the aorta, and for the left, upon and along the side of the aorta. From these are involved the secondary glands which consist of the primary glands of the opposite side and the glands above the renal vessels as well as those behind the great vessels and along the outer side of the common iliac artery. Ferguson[31] showed that, in as many as 90 per cent of normal individuals, at least one lymph channel can be demonstrated ascending above the renal vessels and connecting with the mediastinal chain of nodes.

According to Gray's Anatomy[37] the internal spermatic artery, a branch of the abdominal aorta, accompanies the spermatic cord along the inguinal canal and through the subcutaneous inguinal ring into the scrotum. It then descends to the testis, giving off branches to the epididymis. The spermatic veins emerge from the back of the testis and after receiving branches from the epididymis unite to form the plexus pampiniformis

which constitutes the chief mass of the cord. They ascend along the cord and finally unite to form a single vein which on the right side opens into the inferior vena cava and on the left side into the left renal vein. According to MacKenzie and Ratner,[2] invasion of the veins by continuous growth has been observed even as far as the heart.

Wells[38] states that, in nearly all cases, metastasis occurs to the lumbar glands on the affected side first, then to the mediastinum, and early enter the blood stream to become widely disseminated. In Dean's[15] cases 69 per cent of the lesions metastasized to the abdominal retroperitoneal lymph glands on the side of the abdomen corresponding with the side of the original tumor, 9 per cent to the glands of the left supraclavicular fossa, 8 per cent to the lungs, 7 per cent to the liver, and 1 per cent to the kidney.

Table 1
Age Incidence

Years	Number of Cases
20–29	23
30–39	31
40–49	16
50–59	6
60–69	4
Not stated	3
Total	83

In our series, metastases were found primarily or developed later in the abdominal cavity in 51 per cent of the cases and in 60 per cent of these it was specified being on the same side as the site of the original tumor. Fifteen per cent metastasized to the glands in the supraclavicular region, 13.8 per cent to the lungs, 10.8 per cent to bones, 5 per cent to the liver, 3 per cent to the mediastinum, 2.3 per cent to the brain, 1 per cent to the stomach, and 1 per cent to the colon. A local recurrence with involvement of the inguinal glands was noted in 4.8 per cent of the cases.

TREATMENT

Many types of treatment for malignant growths of the testicle have been advocated. Orchidectomy alone is the oldest form of treatment while different authors have suggested the following methods as a means of producing more lasting cures but without great success: orchidectomy followed by *x*-ray, radium pack, or Coley's serum; orchidectomy followed by a radical resection of the lymph glands; *x*-ray alone; and radium alone.

Orchidectomy is the simplest and most widely used surgical procedure. Hinman[32] has been a strong supporter of the radical operation, believing that this procedure, like castration, must be done early if done at all. He states that "if the radical operation is of use at all it should be used on all patients without clinical evidence of metastases in whom a malignant tumor is proved after castration. When metastases are palpable, the operation is impractical since a clean, complete removal of the lymph nodes in all probability will be impossible."

Table 11
Results in Seven Cases with Clinical Evidence of Metastasis Treated by Simple Orchidectomy

Type of Tumor No. of Cases	Years Followed								
	1			2			3		
	*A.	D.	L.	A.	D.	L.	A.	D.	L.
Teratoma 2	1	1	0	0	2	0	0	2	0
Embryonal Ca. 1	0	1	0	0	1	0	0	1	0
Sarcoma 2	0	2	0	0	2	0	0	2	0
† Clin. Malignant 2	2	0	0	2	0	0	0	2	0
Total—7	3	4	0	2	5	0	0	7	0

* A. —Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.
† Clinically malignant—no pathologic diagnosis recorded.

The operation is done in two stages. The first step consists of a simple orchidectomy

after the cord has been dissected free and divided high in the inguinal canal. This is done to prevent general metastasis from the squeezing of the tumor cells into the blood stream. The second stage attempts the removal of all the lymphatics of the general distribution of the right and left primary and immediate secondary groups. This generalized area has been clearly determined by Hinman[32] as follows: "It may be bounded by an imaginary transverse line from 1–2 cm. above the renal pedicle, by vertical lines extending from this point on each side just outside the vena cava on the right, and from 1–2 cm. outside the aorta on the left to the level of their bifurcation, and follow along the iliac vessels to cross at the upper third of each external iliac and follow these vessels back to about 1 cm. below the bifurcation." This second stage should never be attempted until confirmation of the diagnosis has been made by an expert pathologist.

The part played by *x*-ray in the treatment of malignant tumors of the testicle depends upon their radiosensitivity, and for clinical purposes they may be classed as radiosensitive or radioresistant. It is fairly well established that the seminomata are radiosensitive while the teratomata are radioresistant. However, it is advisable to check the radiosensitivity in each case by the method outlined above. Henline[33] believes that in the case of a radiosensitive tumor without demonstrable metastasis, an orchidectomy should be done, followed by further irradiation for metastasis as indicated by the hormone tests. He advises the radical operation for a radioresistant tumor without evidence of metastasis but, if present, palliative treatment with radium packs or high voltage *x*-ray may be used. The prognosis, however, is very poor.

Coley[39] advocated and used his streptococcus and bacillus prodigiosus toxin in a series of cases in the belief that the serum has an inhibitory action on the growth of the tumor cells. He recommends orchidectomy first, followed by the intramuscular injection of graded doses of the toxin. He also advises massive doses of irradiation to the abdomen and supraclavicular regions.

TABLE III

RESULTS IN TEN CASES WITH CLINICAL EVIDENCE OF METASTASIS TREATED BY SIMPLE ORCHIDECTOMY AND POSTOPERATIVE X-RAY THERAPY

Type of Tumor. No. of Cases	Years Followed						
	1	2	3	4	5	7	10
	*A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.
Teratoma 2	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0
Embryonal Ca. 2	2 0 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0
Seminoma 3	0 3 0	0 3 0	0 3 0	0 3 0	0 3 0	0 3 0	0 3 0
Sarcoma 3	2 1 0	2 1 0	1 2 0	1 2 0	0 3 0	0 3 0	0 3 0
Total—10	4 6 0	2 8 0	1 9 0	1 9 0	0 10 0	0 10 0	0 10 0

* A.—Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.

Every patient, regardless of the treatment instituted, should be closely followed by repeated quantitative determinations of prolan A in the urine as an index of the progress of the disease.

Prognosis. Whatever type of treatment is employed, whether surgical or *x*-ray, the prognosis in cases of malignant tumors of the testicle is grave; however, the outlook for the patient with a radiosensitive tumor is much brighter than that of one with a radioresistant growth. Tanner[24] believes the prognosis is influenced by the pathology of the tumor, mixed tumors being more malignant than the so-called carcinomatous ones.

Table IV

Results in Seven Cases with Clinical Evidence of Metastasis Treated by Irradiation

Type of Tumor No. of Cases	Years Followed				
	1	2	3	4	5
	*A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.
Teratoma 2	1 1 0	1 1 0	0 2 0	0 2 0	0 2 0
Embryonal Ca, 1	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0
†Clin. Malignant 4	1 3 0	1 3 0	1 3 0	1 3 0	0 4 0
Total—7	2 5 0	2 5 0	1 6 0	1 6 0	0 7 0

* A.—Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.
† Clinically malignant—no pathologic diagnosis recorded.

Operative Mortality. The operative mortality for orchidectomy is almost nil while that for the radical operation varies up to 12 or 15 per cent. Roche[14] believes that the radical operation is not justifiable, due to its great risk and high operative mortality.

Results of Treatment. After reviewing the literature as well as our own series of cases, we find the end results of treatment in cases of malignant tumors of the testicle are quite discouraging. Tanner[24] collected 600 cases from the literature in which the postoperative course had been followed in 465. Of these, 377, or 81 per cent, were dead and twenty-five, or 5.5 per cent, were alive and apparently well four years after operation.

Hinman[40] collected a series of 258 cases in which treatment was simple orchidectomy with or without *x*-ray therapy. Of these, 118 patients or 45.8 per cent were dead and 124 were living, but only seventeen, or 6 per cent, had survived for five or more years. Young[23] reported the cases of twenty-five patients who had been treated by orchidectomy. Of these, seventeen were dead and eight living. Eleven, or 61 per cent, lived only one year or less after operation, and of the eight living three had regional metastases and three had lived four years or longer.

Table V

Results in Three Cases with Clinical Evidence of Metastasis in Which No Treatment Was Instituted

Type of Tumor No. of Cases	Years Followed
	1
	*A. D. L.
Seminoma 1	0 1 0
Sarcoma 1	0 1 0
† Clinically Malignant 1	0 1 0
Total—3	0 3 0

* A.—Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.
† Clinically malignant—no pathologic diagnosis recorded.

Hinman[40] has been a staunch supporter for the radical operation. In 1933 he reported the results in eighty cases including nine of his own, in none of which was there any clinical evidence of metastasis at the time of the operation. Of this series 35 per cent had died from metastases.

Sixteen were living less than five years and seventeen, or 20.1 per cent, were alive and well five years or longer. Recently Hinman[32] has reported the results of treatment in a series of fifty-four cases, in twenty-five of which there was no clinical evidence of metastasis when the patient was first seen. Of this latter group, fourteen had the radical operation and ten are living, all with a good prognosis. The remaining eleven patients without evidence of metastasis were treated by castration and *x*-ray therapy. In this group, eight are living, only one with a good prognosis, four with a fair prognosis, and three with a definitely poor prognosis. Of the twenty-nine patients with clinical evidence of metastasis only nine are alive.

Dean[41] cites a series of 154 cases treated by *x*-ray and radium. Of these, forty-four patients, or 29.2 per cent, are alive without evidence of metastasis five years after treatment was begun. Of this group, 115, or 74.6 per cent, were reported as being inoperable on admission.

Coley[39] reports good results in the treatment of neoplasms of the testicle by a combination of orchidectomy and Coley's serum. In a series of sixteen patients, eleven, or 68.7 per cent, lived more than four years and six, or 37.5 per cent, lived more than ten years. However, this form of treatment has been less successful in the hands of other men.

In our series of eighty-three patients, there were seventeen, or 20.4 per cent, five year survivals for the entire group. As previously mentioned, fifty-six of the patients were reported as being free from any clinical evidence of metastasis when first seen, and all the patients living at the end of five years fell in this category, giving a 30.35 per cent five year survival for this sub-group. None of the patients with clinical evidence of metastasis at the time of the first examination lived five years. We

TABLE VI

RESULTS IN TWENTY-FIVE CASES WITHOUT CLINICAL EVIDENCE OF METASTASIS TREATED BY SIMPLE ORCHIDECTOMY

Type of Tumor. No. of Cases	Years Followed						
	1	2	3	4	5	7	10
	*A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.	A. D. L.
Teratoma 5	5 0 0	5 0 0	3 2 0	2 2 1	2 2 1	1 3 1	1 3 1
Embryonal Ca. 11	7 4 0	5 6 0	4 7 0	3 7 1	2 8 1	2 8 1	1 8 2
Seminoma 3	2 1 0	2 1 0	1 2 0	1 2 0	1 2 0	1 2 0	1 2 0
Sarcoma 2	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	1 1 0	0 2 0
†Clinically Malignant 4	1 1 2	1 1 2	0 2 2	0 2 2	0 2 2	0 2 2	0 2 2
Total—25	16 7 2	14 9 2	9 14 2	7 14 2	5 15 4	5 16 4	3 17 5

* A.—Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.
† Clinically malignant—no pathologic diagnosis recorded.

further classified the patients according to the type of treatment instituted and Tables II to VII give the result of this study.

The foregoing follow-up study clearly shows that in those patients in whom clinical evidence of metastasis is demonstrable at the time of the initial examination, the prognosis is extremely poor. surviving ten years were found to be enjoying good health and were free from clinical evidence of metastases, whereas eight, or 47 per cent, of the five year group had metastatic lesions with a poor prognosis. In 89.6 per cent of those known to be dead, the cause of death was attributed directly to the testicular malignancy.

TABLE VII

RESULTS IN THIRTY-ONE CASES WITHOUT CLINICAL EVIDENCE OF METASTASIS TREATED BY SIMPLE ORCHIDECTOMY AND POSTOPERATIVE *X*-RAY THERAPY

Type of Tumor. No. of Cases	Years Followed						
	1	2	3	4	5	7	10
Teratoma 9	*A. D. L. 9 0 0	A. D. L. 4 4 1	A. D. L. 3 5 1	A. D. L. 2 6 1	A. D. L. 2 6 1	A. D. L. 2 6 1	A. D. L. 0 6 3
Embryonal Ca. 12	11 1 0	9 2 1	9 2 1	7 4 1	6 5 1	3 5 4	1 5 6
Seminoma 4	4 0 0	2 1 1	2 1 1	1 2 1	1 2 1	1 2 1	0 3 1
Sarcoma 3	3 0 0	3 0 0	3 0 0	3 0 0	1 1 1	0 1 2	0 1 2
†Clinically Malignant 3	2 1 0	2 1 0	2 1 0	2 1 0	1 2 0	1 2 0	1 2 0
Total—31	29 2 0	20 8 3	19 9 3	15 13 3	11 16 4	7 16 8	2 17 12

* A.—Number of patients living.
D.—Number of patients dead.
L.—Number of patients lost in follow-up.
† Clinically malignant—no pathologic diagnosis recorded.

(Tables II, III, IV and V.) In this group only two patients were alive four years after treatment; 52 per cent died within the first year, and 80 per cent were dead by the end of the second follow-up year. It is interesting to note that both the patients who survived four years had received *x*-ray therapy.

In the other group in which there was no demonstrable metastasis at the time of treatment, the results are somewhat more encouraging. Among these patients, there were seventeen, or 30.35 per cent, five year survivals and five, or 9 per cent, were living at the end of ten years. All the patients

When comparing the results obtained after simple orchidectomy alone and after orchidectomy plus *x*-ray therapy, there was a distinct margin in favor of the latter at the five year period, the comparison being 24 per cent five year survivals for the first group and 35.5 per cent five year survivals for the second. However, the percentages of patients with metastatic lesions were approximately the same, being 49 per cent and 46 per cent respectively. Furthermore, by the tenth follow-up year, there was no appreciable difference in the results, suggesting that the *x*-ray therapy merely slowed up the growth of the tumor and was

not curative. Dr. Portmann states, however, that in this series the patients who were given Roentgen therapy include only a few who were irradiated immediately prior to or after operation, the majority having been treated after metastases developed. In addition, many had treatment during the years when only very meager intensities of radiation could be given as compared with modern methods which unquestionably will give improvement in the results.

SUMMARY

1. Malignant tumors of the testicle are comparatively rare.

2. They may be divided into the homologous and heterologous types of tumor. The former is comprised mainly of the sarcomata and seminomata, the latter consisting of the mixed tumors of adult and embryonal tissue.

3. Testicular tumors occur most frequently between the ages of 20 and 50.

4. The etiology remains unsolved. There was a history of previous trauma in 19.4 per cent of the cases in this series.

5. The incidence of testicular tumors is higher in cryptorchids than in normal individuals.

6. Bilateral testicular tumors are rare. Neoplastic disease seems to involve the right testicle more often than the left.

7. There are no pathognomonic signs, painless swelling of the testis being the first symptom in the vast majority of cases.

8. Gumma, tuberculosis, hydrocele, hematocele, and orchitis must be considered in the differential diagnosis.

9. The hormone test for prolan A is valuable in diagnosis, prognosis, and treatment.

10. Metastasis takes place by way of two routes, namely: lymphatic extension and blood stream dissemination. The majority of lesions metastasize first to the retroperitoneal lymph nodes. The lungs and supraclavicular glands are also frequent sites of metastases.

11. Simple castration, castration followed by *x*-ray or radium, radical operation, Coley's serum, and *x*-ray or radium alone are the usual types of treatment.

12. Results of treatment are discouraging. The best results are obtained in cases without clinical evidence of metastasis. In our series a combination of castration and *x*-ray seemed to give the longest survival. In Hinman's hands, the radical operation in selected cases gives comparatively good results. Dean also reports good results with radiation therapy alone.

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LYMPHOGRANULOMA VENEREUM IN THE FEMALE

A CLINICAL STUDY OF NINETY-SIX CONSECUTIVE CASES

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LYMPHOGRANULOMA venereum is a venereal infection of virus origin with a remarkable predilection for lymphatic structures. The disease manifests itself by a primary evanescent genital lesion and subsequently by one or more subacute to chronic secondary localizing lesions. These are inguinal buboes, genital elephantiasis, rectal stricture and warty papillary excrescences or polypoid growths about anus, vulva, urethra and in the rectum and vagina. Ulceration commonly occurs either as a continuation and extension of the primary lesion or as a sequel to lymph stasis. Rectovaginal fistulae and ischiorectal abscesses are occasionally observed. Frequently systemic reactions occur.

Etiology. Lymphogranuloma venereum is due to a filtrable virus, immunologic response to which is shown by the Frei test. This test, when positive, remains so throughout life. It is a venereal disease which affects all races but in America is predominately found in the colored race. In our locality more white males are affected than white females. The highest incidence occurs during the most active period of sex life. The incubation period is inconstant and varies greatly. The primary lesion usually occurs ten to fourteen days after exposure and the adenitis twenty-one to thirty days. In an 11 year old girl with a history of a forced coitus (rape) the bubo appeared one month later. Twelve to forty days and longer may elapse from the time of the primary lesion before a positive Frei test is obtained.

In our series of cases there were ninety-two colored and four white females. Three of the white women, aged 26, 27 and 28 respectively, were married. One husband was tested with Frei antigen and reacted positively. The other white female, aged 20, was unmarried. Salpingitis was a complication in this patient. The colored women ranged in age from 11 to 56, nineteen being 20 or less and thirty-four from 21 to 30.

There is a high incidence to other venereal diseases in this group of patients. Twenty-seven either had active chancroid lesions or were positive to the intradermal chancroid test. Fifty-five either had a positive serologic test for syphilis or had been under treatment for this disease. Lesions of granuloma inguinale (diagnosed by finding Donovan bodies in smear or in tissue section) occurred in seven of this series. Three colored women had all four of the above venereal diseases and may have had gonorrhea in addition, inasmuch as no note of latent gonorrhea was made in this study. A considerable number have had salpingitis and several had been operated upon for this condition.

The time of appearance of the initial lesion according to the months of the year, where it was possible to determine, is recorded as follows:

January	5
February	1
March	3
April	3
May	2
June	1
July	2
August	4
September	4
October	2
November	1
December	2

Clinical Manifestations. Usually within two or three weeks after exposure a primary, often transitory, papule or vesicle may develop. This may quickly heal and the patient rarely connects it with the later manifestations which occur within a few weeks. Fever, joint pains and malaise are frequent systemic reactions accompanying unilateral or bilateral inguinal adenitis. Because this disease attacks the lymph channels and glands there may result localized elephantiasis of the vulvar region, labia and clitoris, or production of nodular tags of tissue about the anus or urethra, leading to the various inguinal, urethral or anal syndromes. Some of these lesions may ulcerate, become secondarily infected and heal with difficulty. The ulcers may excavate, especially when combined with other infections as chancroid, syphilis, fusospirochetosis, or secondary infection by other organisms. All manifestations may occur with or without fever which may be remittent and sometimes chronic.

Types. Genital. This is characterized by blockage of the lymph channels with resulting chronic edema and ultimate ulceration of the skin. There is a tendency to formation of elephantiasis of the labia, especially the labia majora, and of the clitoris. Deep, suppurating subcutaneous abscesses may develop. These may rupture through the skin and cause persistent fistulous tracts. Healing and scar tissue occasionally result in stricture or fistula of the vagina. In this series there were thirty-five ulcerative lesions located as follows: vulva 18: vagina 14; cervix 5; anus 2; buttocks 2. Elephantiasis occurred in twenty-three patients and in the following structures: vulva, either one or both labia majora, 20; clitoris 5. Seven of the above patients had both ulceration and elephantiasis. There was one stricture of the vagina.

Inguinal Adenitis and Buboes. Possibly due to the difference in lymph drainage, this is less common in the female than in the male. Nevertheless it occurs quite frequently, producing unilateral or bilateral adenitis with definite tendency to focal softening and subsequent drainage through multiple fistulous tracts. Twenty-nine of these patients had buboes and four had a history of buboes. The location of the bubo or buboes was about equally divided among the three possibilities, right, left and bilateral. In two patients with buboes in whom both the Frei and chancroid tests were positive, the Ducrey bacillus was isolated from the aspirated pus in pure cultures.

Anorectal Syndrome. This may be a subacute proctitis with redness, swelling and discharge from the mucosa. It may be chronic with resultant benign fusiform stricture of the rectum as though a rubber band of varying width were tightly wrapped around the rectal mucosa. This stricture, although it may be narrow longitudinally, is usually fusiform and regular in outline. It begins almost abruptly from a few centimeters to 8 to 10 cm. above the anus and extends upward a variable distance, sometimes to a length of 10 cm. In the early cases the constriction readily admits a finger but in the later ones hardly a knitting needle. While it is not strictly elastic, moderate dilatation is possible in the early stage. All patients with rectal strictures not due to trauma of hemorrhoidectomy, have had a positive Frei test. In addition to the stricture there is a definite tendency for verrucous tags of epithelium to develop at the anal orifice. Rectal strictures occur commonly in the female, possibly because of the relationship of the posterior vaginal wall to the rectum. This condition occurred in twenty-two

patients, i.e., about 23 per cent of the cases. In eleven patients it was uncomplicated. It was associated with elephantiasis of the vulva in one patient; with vulvar ulceration in one; with urethral syndrome in one; with history of bubo in three; with previous colostomy in three; and with carcinoma of the anus in one. In the last two years the strictures have been gently dilated once a week with the gloved fingers. Colostomies have thus far been unnecessary. Anal tags were present in eight cases.

Urethral Syndrome. In some cases there is a tendency to development of papillary elevations of mucosa about the urethral meatus with inclination to loss of sphincter action. The accompanying symptoms, which are often intractable, are dysuria, frequency, and later incontinence, and in this series it was noted that there was a tendency to ulceration about the meatus.

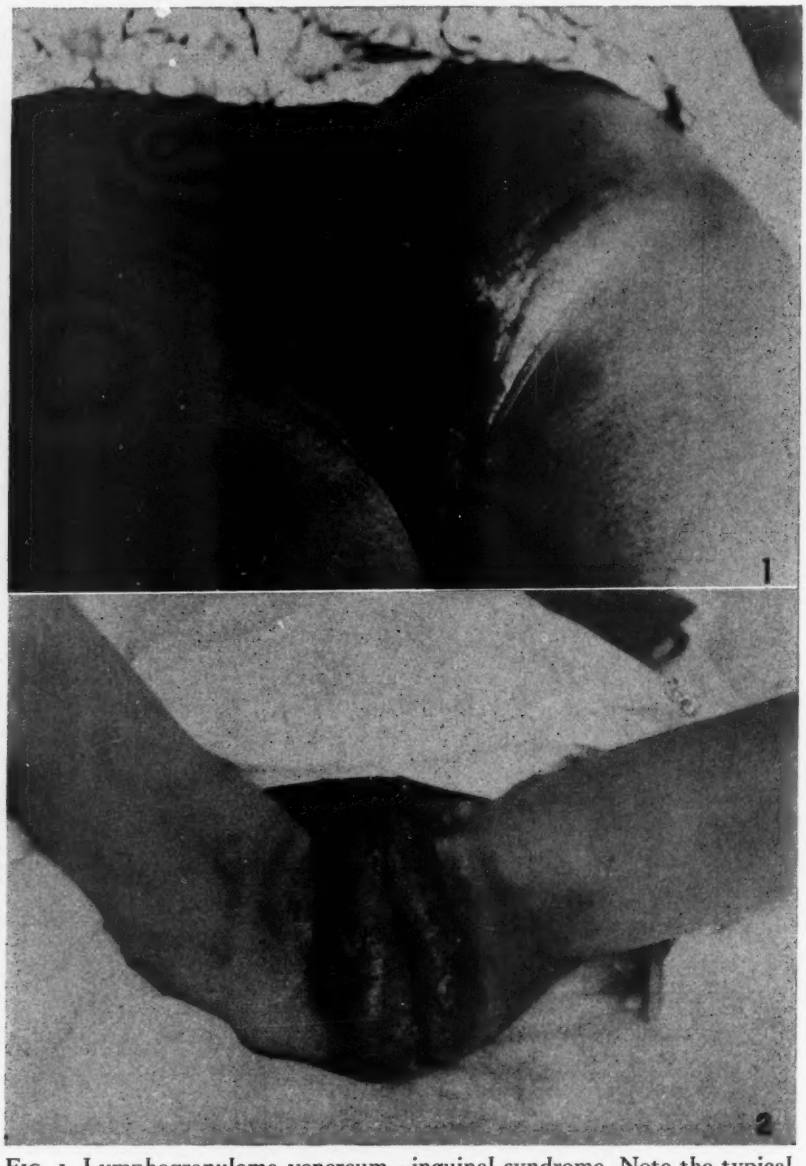

FIG. 1. Lymphogranuloma venereum—inguinal syndrome. Note the typical multinodular type of bubo.

FIG. 2. Lymphogranuloma venereum—genital syndrome. Note the elephantiasis of the vulva.

We have never observed a urethral stricture in any of our patients. Six patients presented the urethral syndrome; all were complicated except one. Most of them were in association with vulvar lesions and one with rectal stricture.

Diagnosis. In the earliest manifestation of the initial lesion a nigrosine or dark-field study is necessary to eliminate syphilis. A smear study should be made for Ducrey bacilli to differentiate, if possible, chancroidal infection. The adenitis and bubo must be distinguished from those of chancroid, syphilis, gonorrhea (rare) and from the early inguinal lesion of granuloma inguinale (venereum) as well as from inguinal tumors, herniae, hydroceles, etc. The vulvar lesions may be simulated by granuloma inguinale, chancroidal infection, syphilitic lesions, tuberculous ulcers, or by epithelioma. In the tropics it is also necessary to differentiate the elephantiasis from that due to filaria Bancrofti. The urethral syndrome may be initiated by a urethral discharge which may be mistaken for that due to gonorrhea. The rectal stricture must be distinguished from that due to malignancy or to trauma of operative procedures. The anal tags may simulate hemorrhoids.

Consequently it is almost essential to inaugurate a diagnostic routine for all of these cases somewhat as follows: serologic blood test for syphilis; Frei intradermal test for lymphogranuloma venereum; intradermal bacillary antigen tests for chancroid. These skin tests should be read at forty-eight hours and the central papules or area of induration should be 7 mm. in diameter with a halo of erythemata of 14 mm. in diameter for a positive reaction. Smears of ulcers should be studied for Donovan bodies, Ducrey bacilli, fusospirochetes, and other secondary invaders. A biopsy of ulcerated tissue should be sectioned and stained for tubercle bacilli, carcinoma or Donovan bodies.

Therapy. Chemotherapy has been disappointing, as has been the experience in other virus diseases. Anything which increases general resistance is indicated. This should include improved general health by good food, rest and vitamins, active treatment of complications as syphilis, granuloma inguinale, gonorrhea, chancroid and especially secondary invaders of ulcerations. Active immunity seems to be enhanced in many cases and in some remarkably by repeated Frei intradermal tests or repeated subcutaneous injections of Frei antigen. In one case of rectal stricture in a white female the use of transfusions from the husband who was a Frei positive with a previous history of infection gave marked temporary relief. It may be that passive immunity holds great possibilities.

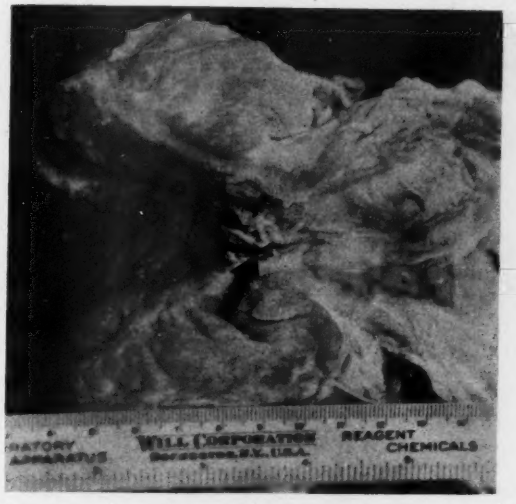

Fig. 3. Lymphogranuloma venereum—rectal syndrome. Arrow points to the stricture of the rectum. This patient developed an epithelioma at the anal margin.

More recently intravenous injections of small amounts (0.05 to 0.3 c.c.) of Frei antigen have been employed in therapy, but its value over subcutaneous injections has not as yet been evaluated. Excellent results have been obtained with the use of sulfanilamide.* It is of value only in draining buboes, sinus tracts, ulcerations, etc., by its probable action on secondary con-

* Sulfanilamide used in this study was provided by the Department of Medical Research of the Winthrop Chemical Company, Inc., in the form of Prontylin—5 gr. tablets.

taminants. Ulcers frequently heal, proctitis and rectal leucorrhea abates and drainage from sinuses ceases. However, it does not seem to have any definite effect on the secondary lesions per se, such as the rectal stricture, chronic elephantiasis, or growths and papillary excrescenses about the genitalia.

FIG. 4. Lymphogranuloma venereum—genitourinary syndrome. Note the papillary excrescences about the urethral orifice. This patient also has vulvar elephantiasis.

Fluctuant buboes should be aspirated as often as necessary but should not be incised because intractable ulceration may result. Furthermore, the sterilized pus is of value in preparation of Frei antigen. This should be standardized with known antigen. Ulcerations are best treated by cleanliness and elimination of secondary invaders by weak antiseptic and oxidizing solutions. Fusospirochetosis is well managed by a mixture of arsphenamine 4½ per cent in equal parts of glycerine and cod liver oil. This may be applied directly or as a saturated dressing and is more comfortable if a 1 or 2 per cent solution of a local analgesic is added. As an alternative, a creamy paste of cod liver oil-zinc peroxide mixture may be used. It is less expensive and is quite efficacious.

Rectal strictures are probably best dilated gently once a week. Neglect of this form of therapy on the part of the patient or physician will in the great number of cases ultimately lead to colostomy for relief of an advanced stage of stricture. Since we have inaugurated active treatment of the stricture by repeated dilatation we have not had to perform any colostomies. In the case of elephantiasis and polypoid growths the patient may be greatly benefited by surgical removal of redundant tissue by partial or complete vulvectomy or clitorectomy.

SUMMARY

1. Ninety-six consecutive cases of lymphogranuloma venereum in the female are

analyzed and are found to fall into four overlapping groups, i.e., genital, inguinal, anorectal, urethral syndromes.

Fig. 5. Lymphogranuloma venereum—inguinal genito-anal syndrome. Note the left inguinal bubo, the multiple draining sinuses and swelling of the left vulva, and the sinus on the inner fold of the left buttocks draining an ischiorectal abscess.

Fig. 6. Lymphogranuloma venereum—genito-anorectal syndrome. Note the elephantiasis of the clitoris and labia, the anal growths. This patient also has a rectal stricture.

2. Various therapeutic measures are recommended. A specific has as yet not been found. Sulfanilamide has proved a valuable adjunct to therapy. It is of value in checking the rectal leucorrhea that is so often attendant upon rectal stricture, as an aid in the healing of ulcerations, and in permitting drainage from ischiorectal abscesses, sinus tracts and draining buboes to cease. However, thus far but little effect has been observed on the secondary lesions per se, such as rectal stricture, elephantiasic vulvae, or papillary excrescences and growths about the genitalia.

ADDENDUM

Since submission of this paper for publication, we have studied forty-nine new female cases of lymphogranuloma venereum. The distribution of the lesions, the clinical course and symptomatology are much the same as those already described in this analysis. In one patient 5 years of age, bilateral buboes followed attempted rape. Two colored women had

abscesses in the rectovaginal space which were associated with rectal disease. Further observations on sixteen cases treated with sulfanilamide bear out our earlier findings. It is a valuable adjunct to the therapeutic armamentarium. We cannot, however, share the enthusiasm expressed in some recent reports, particularly that of Gjuric (*München. med Wchnschr.*, 85: 335, 1938). We are in agreement with the conservative report of Shaffer and Arnold (*Arch. Dermat. & Syph.*, 87: 7305, 198).

FIG. 7. Lymphogranuloma venereum—genital syndrome. Note the elephantiasis of vulva, clitoris, the pendulous polypoid mass (right lower vulva), and the papillary excrescences.

FIG. 8. Lymphogranuloma venereum—genito-anal syndrome. Note the elephantiasis vulvae and the perineal ulceration and growths.

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LEVATOR HERNIA, PERINEAL AND PUDENDAL*

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A HERNIA presenting in the perineum or in the pudendum is a very rare occurrence.

Considerable confusion existed in the classification and nomenclature of hernia at the pelvic outlet until Chase presented his classic paper in 1922. After a review of the literature, cadaver dissections and the successful repair of a pudendal hernia, he concurred in the suggestion of J. A. Blake that the term "levator hernia" is most appropriate, as the primary and essential anatomic feature is a rent in the levator ani muscle.

Anatomic Considerations. A study of the pelvic diaphragm shows that the iliococcygeus portion of the levator does not overlap the central portion (pubococcygeus) laterally, but passes onward to fuse directly with the pubococcygeal and rectococcygeal raphé. This leaves a weak point or space on each side in the pelvic diaphragm, closed only by the pelvic or rectovesical fascia above and separated only by areolar tissue from the ischiorectal fascia below.

Anterior to the broad ligament the levator is fused in a complete layer. This explains why all reported cases with exit at this point were traumatic in origin.

Levator hernia may be divided into the rare congenital or more usual acquired forms, and each group subdivided into the perineal and pudendal types. The latter is again divided into: (a) anterior to broad ligament (direct, subpubic); and (b) combined (indirect anterior) varieties.

A perineal hernia presents in the ischiorectal fossa posterior to the transversus perinei muscle. The boundaries of the internal ring are the board ligament anteriorily, the sacro-uterine ligament and the rectum mesially and an imaginary line between the two sides of this angle. The sac is completely lined with peritoneum. The hernia then perforates the rectovesical fascia and the ischiorectal fascia, descending into the ischiorectal fossa. The sac usually contains bowel, less frequently the tube and ovary.

Pudendal hernia may be anterior to the broad ligament (direct) or combined. The boundaries of the internal ring in the anterior variety are the uterus and the bladder mesially, the round ligament externally, and the transversus perinei muscle and the vagina below. The sac is incomplete, as the bladder, which forms the contents of the sac, has only a partial covering of peritoneum. The point of exit is bounded mesially by the vagina, externally by the ascending ramus of the pubic bone, and posteriorily by the transversus perinei muscle.

After perforating the rectovesical fascia only, the posterior variety may pass downward and forward beneath the broad ligament before perforating the levator. There thus results the combined (indirect anterior) variety, which contains both bowel and bladder.

A pudendal hernia always makes its exit through the suprapubic triangle, protrudes into the posterior part of the labium majus, and vaginal mucosa invests its mesial surface.

The perineal and the combined pudendal are always the "sliding" type of hernia.

Etiology. The anatomic and mechanical factors common to all hernias operate to produce levator hernia. The majority of pudendal hernias, however, have followed

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pregnancy and labor, especially the trauma of instrumental delivery.

Diagnosis is made upon the history of a trauma or unusual physical effort, followed by a swelling in the perineum (buttock) or labium majus. The tumefaction may be tympanitic on percussion, imparts an impulse on coughing, is reducible, and its course may be traced by palpation as the hernia is reduced.

Prognosis. A V. Moschcowitz, in an admirable review of the literature (1918) going back to the eighteenth century, found only twenty-eight cases reported as levator hernia, twenty of which were merely clinical observations. In many of these the data were incomplete; four others were operated upon and the remaining four were examined post-mortem. His personal case was a female child of two and one-half years, who had a moderately firm smooth swelling in the right buttock. Incision disclosed the mass to be a subperitoneal lipoma, 6 inches long by 2 inches wide, with a hernia through a hiatus admitting two fingers between the levator ani and the coccygeus muscles. The opening was closed with interrupted sutures of chromicized catgut, reënforced by suturing the lower margin of the mobilized gluteus maximus to the deep pelvic fascia. There was no recurrence ten months later.

Pudendal hernia has usually been considered to be incurable. In the thirteen authentic cases collected by Chase, his own patient was the only one cured by operation (five years). Grattan felt that in the case he reported, the exit corresponded to the cases of pudendal hernia described by Cooper in 1807, and to the cases collected by von Winckel in 1881, which were reviewed by Moschcowitz who listed eleven authentic cases, all in females.

Treatment. Effort should be made to apply the general principles of surgical repair of hernia, namely, high ligation and excision of the sac with closure of the internal ring. Pudendal hernia is a special problem for the gynecologist. Perineal hernia usually presents no insurmountable difficulties of operative technique. If, as generally occurs, intimate adhesions to adjacent structures or to the perineal skin prevent excision of the sac, the internal ring may be closed by suture, with or without circumcising the peritoneum at its margin; or the sac may be obliterated by purse-string sutures of linen, according to the technique of Moschcowitz, as in the following case.

CASE REPORT

Mrs. A., 71 years of age, consulted me in 1935 for abdominal cramps, pelvic pain and frequent bloody dejecta of five months' duration. She was a frail woman, weighing 98 pounds. She was childless and had had an ovariotomy when 36 years old. She suffered from a chronic bronchial cough.

Examination revealed a neoplasm of the rectum 2 inches in length, involving the anterior two-thirds of bowel circumference. The lower margin of the growth was 2 inches above the anal verge. Biopsy showed adenocarcinoma, grade 2.

On December 18, 1935, I established a loop sigmoidostomy under local anesthesia. There was no gross involvement of the liver. Several diverticula containing fecaliths studded each side of the distal half of the long sigmoid, but the mesenteric lymph nodes were not enlarged. The atrophic uterus was in normal position. Three weeks later, under spinal anesthesia, perineal excision of the rectum was performed, during which the cul de sac was opened. After about 4 inches of the sigmoid had been drawn down, the peritoneum was sutured to the sigmoid with interrupted stitches of chromicized catgut. Three months later the perineal wound was completely healed.

Four months after the perineal proctectomy, the patient complained of a bearing down feeling in the pelvis which was relieved when reclining. This became worse, and was accompanied by occasional colicky pain in the lower abdomen.

Examination in July 1936 showed that on straining, a bulging the size of a lemon appeared in the right side of the healed perineal skin. This swelling was soft, tympanitic on percussion, and imparted an impulse on coughing. Its easy reduction was accompanied by a gurgling sound. Palpation indicated that the

internal opening was posterior to the broad ligament and to the right of the pelvic colon.

On August 25, 1936, under spinal anesthesia, the abdomen was entered through a lower left rectus incision. No adhesions were present. With the patient in the Trendelenburg position, it was seen that the true pelvis was occupied by the small intestine, loops of which were prolapsed into but were not adherent to the peritoneal sac at the bottom of the pelvis. The internal opening of the sac, about 1 inch in diameter, was posterior to the broad ligament and just to the right of the pelvic colon. The sac was about 2½ inches in depth and so adherent to the thin perineal skin that it could not be separated. While an assistant held the sac inverted by counter-pressure through the perineum, a purse-string suture of linen was placed just above its apex. Three other similar sutures were then placed at intervals of two-thirds of an inch and when all were tied the sac was completely obliterated. Anterior suspension of the atrophic uterus was effected by two sutures. The abdomen was closed without drainage. Convalescence was smooth. To date (nine months) the patient has had no symptoms referable to the hernia and there are no signs of recurrence.

Of the many cases of perineal excision of the rectum for carcinoma, with permanent colostomy, that I have done, to my knowledge this is the only one to be followed by a perineal hernia. I attribute its occurrence chiefly to the strain of the persistent coughing due to the chronic bronchitis.

SUMMARY

Anatomic studies indicate that a levator hernia descends through a point in the pelvic diaphragm naturally weak or weakened by a trauma.

Levator hernia was rarely congenital; usually it is acquired and is classified as perineal or pudendal.

The boundaries of the internal ring, course and site of external presentation of the two varieties are described.

Cases in the literature are briefly summarized and the writer reports the successful repair of a perineal hernia in a woman, aged 71 years, which followed proctectomy for carcinoma of the rectum.

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THE USE OF PROLONGED ANESTHESIA IN ONE HUNDRED RECTAL CASES

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IN the past, rectal operations under strictly local anesthesia have been rather generally avoided by the average practitioner. Spinal, inhalation and other forms of anesthesia have been preferred and as a result, such operations have not shown a trend towards simplification, as many of us would prefer. The possibility of handling patients suffering from rectal conditions in the office has been almost entirely eliminated, and many simple lesions have been allowed to go on to more serious conditions, chiefly because of the patient's fear of hospitalization.

We can note with relief, therefore, the promised benefits of the newer oil-soluble anesthetics which can be utilized in either office or hospital with great advantage in the average rectal case.

The author has had occasion to use several different compounds for rectal anesthesia, but one in particular, neothesol, has given great satisfaction both from the standpoint of adequate anesthesia and freedom from complications.

Neothesol is composed of two parts of methyl methylene para-aminophenyl-formate and five parts of hydroxbenzo-carbinol in refined almond oil. It contains no phenol and has a benzyl alcohol content of 2 per cent, which is considerably lower than the 10 per cent in most of the oil-soluble preparations. Due to its viscosity, it must be withdrawn from the ampule through a gauge 15 needle, but it can be injected through one of 20 gauge, which is a convenient size and one easily manipulated.

The actual technique of administration is something that cannot be done in any casual manner. Despite its similarity to simple local solutions, there are many important points in which the two classes of solutions differ. One had best begin with a careful anatomic study of the anorectal region because an accurate contact with the nerve fibers is essential. Very little help can be expected from the convenient process of diffusion. As a matter of fact, diffusion would soon nullify the property by which its action is prolonged.

The anatomy of the anal nerves, which is our principal concern, is not so complicated as some of the books would have us believe. The varied terminology was somewhat confusing to the writer, and he found it helpful to dissect several cadavers and actually observe these nerves as they entered the muscles and other structures. A slight amount of variation was noted in some specimens, but it was possible to sum up a conception of these structures in a fairly concise and diagrammatic way.

There are three nerves that are of importance: (1) the coccygeal, (2) the inferior hemorrhoidal, and (3) the sympathetic plexus. The bony anatomic landmarks are easy to find; there are three of them—the right and left ischial tuberosities and the coccyx. If the examiner will place his index finger in the rectum and palpate these landmarks from within, he can estimate with a considerable degree of accuracy the position of the two nerves that supply the skin and sphincter muscles.

The finger will note that the ischial tuberosities are almost directly lateral to the anal ring, and that the coccyx is directly posterior to it, thus forming a right angle. A line dividing this angle in half, or 45 degrees from either bony landmark, will indicate the position of the inferior hemor-

hoidal nerve as it enters the ischiorectal space. The coccygeal nerve, descending from the fourth and fifth sacral, runs, as its name implies, directly from the region of the coccyx to the posterior anal margin. Several fibers of this nerve may exist, some of which are to be found in close proximity to the anococcygeal ligament, while others may be a good inch and a half away from this structure. However, the fibers run parallel to each other and for this reason, can be the more easily visualized. The fibers of the inferior hemorrhoidal nerve enter the outermost border of the sphincters, starting about where the coccygeal nerve leaves off, and progressing onward to the anterior portion of the sphincter muscles and the overlying skin.

The mucosa of the anal canal above the pectinate line receives fibers from the sympathetic group. We are told that these sympathetic nerves are sensitive to traction only, but the act of ligating or clamping in this region will produce ample pain sensation unless the nerves have been well blocked off. The fibers are very fine; they lie in the wall of the gut and completely encircle it in the region of the internal sphincter. Other nerves which give off a few fibers to this area are of no great importance at the moment, and they will be blocked off during the process of caring for the nerves already mentioned, because of their close contiguity.

At any rate, due regard must be had for the vessels that accompany these nerves, because it has always seemed to the author that there must be some practical connection between the spelling of "hemorrhoid" and "hemorrhage." Using a large caliber needle, one must be doubly careful, and yet, when ecchymosis has occurred, as was the author's experience in a few instances following accidental puncture, no harmful results ensued. The anatomy of the muscles in this region and the knowledge of the hemorrhoidal veins, crypts, etc., is so familiar that there is no point in entering into a discussion of that subject at this time. The anatomy described is clearly shown in the accompanying diagrams.

The actual technique of administering this type of anesthetic is as follows:

A point is selected midway between the coccyx and the anal margin, and a wheal is raised in the skin, with novocaine solution. Through this wheal is inserted a 20 gauge needle 2½ inches long, attached to a 10 c.c syringe filled with neothesol. The needle should be inserted to half its depth in order to reach the coccygeal nerves. The solution must be constantly expressed from the syringe, both during insertion and withdrawal, avoiding the filling of any one area with any considerable amount of the liquid. The usual fan-shaped region should be covered, its greatest width extending to slightly more than an inch to either side of the midline, with some of the liquid injected directly into the anococcygeal ligament. The resultant anesthesia will cover the posterior portions of the structures of the anal ring.

The next step is to anesthetize the branches of the inferior hemorrhoidal nerve on both sides. This nerve supplies the lateral and anterior portions of the anal ring. Without fully withdrawing it, the needle is deflected laterally, and infiltration is carried out all along the lateral border of the sphincter muscles, the solution being deposited into the muscle tissue. If one wishes to be bold, the needle may be inserted its full length into the ischiorectal space, directly toward the ischium, thus blocking the nerve itself as it appears from under the gluteus maximus. There is some risk associated with this procedure, however, and it is a maneuver which is not entirely necessary. One can make sure that the sphincters are well infiltrated because their blood supply seems to offer a good defense against injury from the oil. Both the internal and external sphincter muscles receive some of the anesthetic and satisfactory relaxation should be produced immediately if infiltration is accurate.

The subcutaneous tissues, already partially anesthetized by the earlier infiltra-

tion, are now taken care of, still without withdrawing the needle from the original point of puncture. It is important to avoid

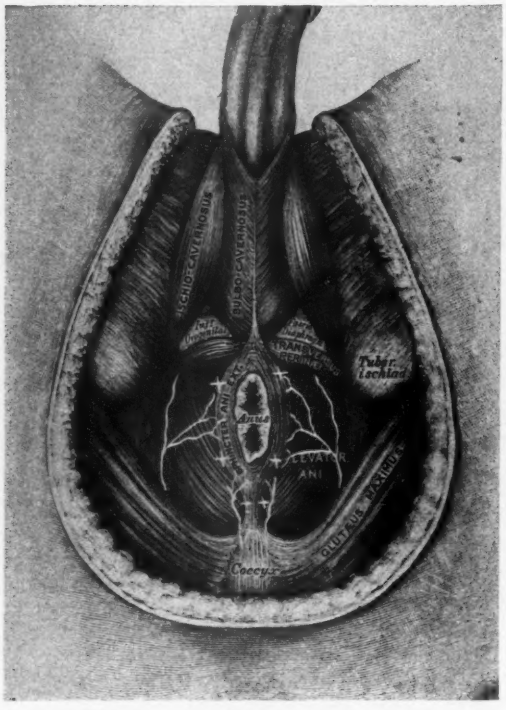

FIG. 1. The coccygeal nerves are seen running from the coccyx to the posterior border of the external sphincter. The inferior hemorrhoidal nerves are seen running from the pudendal nerve to the lateral and anterior borders of the sphincter. The small crosses indicate some of the suggested points of infiltration.

getting the solution too near the superficial layers, not only for the purpose of avoiding sloughing, but also to guard against distortion of the structures to be operated upon. These heavy oil solutions can cause absolute disappearance of an external hemorrhoid by ballooning the tissues in a manner which is far more disconcerting than any ever experienced with novocaine.

Having anesthetized the posterior and lateral areas, the anterior perineum is treated in the same manner, again using the small wheal of novocaine about an inch anterior to the anal ring, through which the larger needle is again introduced. The subcutaneous and muscular structures, which were not reached by the posterior infiltration, are then well anesthetized.

The third group of nerves to be anesthetized is the sympathetics, which descend from above within the wall of the rectum. This is done by deep insertion of the needle, parallel to the axis of the gut and reaching a point where the mucous membrane rolls over the belly of the internal sphincter muscle. Small quantities of neothesol must be deposited throughout the entire circumference of the rectum at this level. This can be easily done from the two points of entry, using the finger inside the rectum as a guide. Only small quantities can be placed at each site of injection since any ballooning of the mucosa is followed thirty minutes later by intense burning. The mucous membrane seems capable of handling the situation without slough, but its distention causes the patient to complain of unbearable stinging which takes a few hours to wear off. The palpating finger can easily recognize the gentle distention of the tissues which is required, and the result is satisfactory anesthesia.

Having encircled the area with the anesthetic and having produced relaxation sufficient to permit of easy dilatation of the ring with two fingers of either hand, one can now proceed to place a few drops of the solution under the lesion itself. This insures a painless approach and permits the operator to draw down, by means of gentle traction, the offending hemorrhoid or polyp, or to spread the tissues widely and permit a full view of the fissure.

The technique described provides complete anesthetization and makes it possible to accomplish an entire hemorrhoidectomy. However, the smaller or more isolated lesions do not require as thorough a procedure, and the anesthetic can be used to desensitize only a particular portion of the circumference of the anus. For an anal operation the sphincters must be well relaxed as otherwise a clear view of the operative field cannot be obtained. If one makes sure of this point, he can use his own judgment as to how much of the superficial area should be anesthetized.

There are a few drawbacks in connection with this compound, and a number of obvious precautions immediately come to

mind. One of these is the necessity of avoiding pooling of the solution in any part of the area involved; necrosis is likely to result from the continued presence of any foreign body in the tissues, and almond oil, with its contained chemicals, is no exception to this rule. Small quantities of it, however, are well tolerated and present no difficulty when caution is observed. Another point which we would all think of at once is the danger of injecting such a heavy substance into the superficial layers of the skin. The resultant distention would be too great to be tolerated, and necrosis or sloughing would follow. Therefore, it is preferable always to use novocaine for the skin wheal. A further contraindication to this method is the presence of acute infection, and one should not consider breaking this rule under any circumstance.

One more difficulty to be faced is the failure of producing proper anesthesia, either at the time of operation or during the postoperative period. This occurred in a small proportion of the earlier cases in this series. We have all experienced some trouble of this type in the use of ordinary local anesthetics, and have many times solved the problem by using larger quantities of the solution. This gross method cannot be resorted to with the oil preparations because sloughing is likely to result, as has already been suggested, from the pooling of too much material in any one area. It is best, then, to rely upon an accurate technique, based on anatomic knowledge of the location of the various groups of nerves concerned.

What results can be expected from the judicious use of these oil-soluble solutions? The writer has reviewed a series of 100 cases, most of which were treated in the office. In this group were included operations upon anal papillae, fissures, fistulae, polypi and hemorrhoids. Among the latter there were fifty-three complete hemorrhoidectomies. Without arranging a lengthy set of statistics, the results can be summarized as follows:

1. The solution is easy to administer.

2. It gives immediate and satisfactory anesthesia, when once the principles of its use are fully understood.

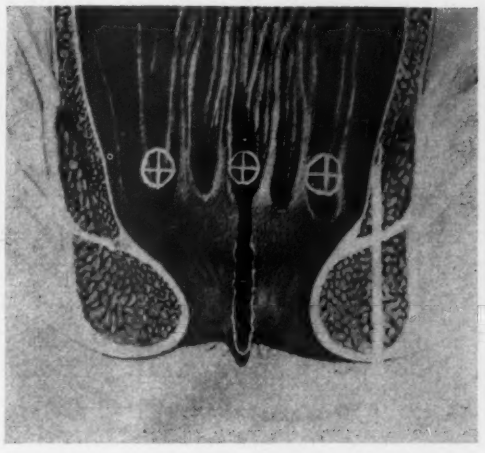

Fig. 2. Cross-section showing infiltration of the mucosa over the belly of the internal sphincter to anesthetize the sympathetic nerves. The lesion shown is that of fissure. The crosses indicate a few of the points of infiltration.

3. Anesthesia does not wear off at the end of an hour, as is the case with the average local solution, but its effects persist and require from one to three weeks to disappear. During this time, the sphincters are partly relaxed, thereby aiding defecation, but in no way causing incontinence.

4. Marked edema of the parts, which was once considered an unavoidable result of hemorrhoidectomy, is now conspicuously absent. The explanation for this undoubtedly lies in the partial relaxation of the muscles previously alluded to.

5. Most helpful of all, the necessity for catheterization has been completely eliminated. In this series in not a single instance was catheterization required.

Three of the patients in this series were physicians and they described accurately the duration of the anesthesia as lasting anywhere from ten to twenty-one days.

In conclusion, it can be said that this method, in experienced hands, is of value as an office or hospital procedure, and possesses the further advantage of requiring only a minimum of attention at home because of the almost complete absence of postoperative pain and edema.

STUDIES ON THE ABSORBABILITY OF CATGUT*

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ONE wonders why, when the majority of modern surgical operations are fairly well standardized, there should be no uniformity of opinion as to the most satisfactory suture material to employ in these procedures.

It is not within the purpose of this paper to submit further proof of the superiority of fine silk over any catgut in the clean surgical wound, but rather to determine what size and kind of catgut most nearly shares the advantageous features of fine silk. When silk is properly used, these advantageous features are: (a) minimum wound reaction in healing; (b) minimum infection in potentially clean wounds; and (c) firm support of the wound throughout its critical healing period. From a workaday standpoint, the meticulous technique demanded in the employment of fine silk discourages its application by those not trained from their first years in surgery to its use. The absorbable suture does get good results with a rougher, more rapid technique; it is unquestionably less tedious and more convenient to use.

Conceding it to be the most popular suture material, there is still great difference of opinion as to what type is most suitable for certain work. For instance, when various surgeons were submitted questions concerning their choice of types of catgut, marked differences of opinion were discovered. To close the peritoneum some used plain 0 or 1, others chromic 00. For the fascia, the choices ranged as follows: chromic 00, chromic 0, chromic 1, plain 0, plain 1. For intestinal work the choices were: chromic 00, plain 00, plain 000. Opinions on absorbability were likewise at variance. One thought that plain catgut is absorbed in from five to ten days; another stated that plain catgut holds two or three days and chromic from ten to twelve days; still another said that plain fails to function after twenty-four hours, and chromic after four to five days; and a fourth: that the safe absorption limit for plain catgut is ten days.

Harvey* has shown that the strength of a clean healing wound (which is dependent upon the orderly proliferation and function of the fibroblasts) follows a curve. For the first four days there is little inherent holding power in the wound, and the suture must provide all the support. From that point on, coincident with the appearance and multiplication of fibroblasts, there is a sharp increase in wound strength up to the eighth or tenth day, when as maximum strength is approached, the curve tends to flatten. By the fourteenth day, the suture is no longer needed for holding purposes. This is as true of the submucosal fibrous supporting layer in the stomach or intestine as it is of the fascia in the abdominal wall.

Briefly, then, the perfect suture will hold adequately for those fourteen days and then disappear, but it must not, during its stay in the tissues, adversely affect the rate of wound healing. Not being certain what size and type of catgut most nearly meets these requirements and finding wide disagreement about it among catgut users, a histologic answer was sought experimentally.

Healthy adult dogs were etherized and subjected to gastroenterostomy under standard surgical conditions. The gastro-

* HARVEY, S. C. The velocity of the growth of fibroblasts in the healing wound. *Arch. Surg.*, 18: 1227–1240 (April) 1929.

* From the Division of Surgery, Northwestern University Medical School. Read before the Chicago Surgical Society, January 7, 1938.

enterostomies and the abdominal wounds were each closed with the suture to be studied and at intervals of twenty-four hours, four days, one week, two weeks, and four weeks the wounds were examined grossly for the state of healing, persistence of functioning suture (catgut with a demonstrable residue of tensile strength), persistence of gross fragments of catgut, and, incidentally, peritoneal adhesions. Both the gastroenterostomy and the abdominal wound in each case were examined microscopically after being blocked in celloidin. This permitted microscopic correlation with the gross impression of the state of healing. Special points looked for in the slides were:

Fig. 1. 000 chromic in abdominal wall at four days. Thirty to fifty cell layers of phagocytes are surrounded by islands of fibroblasts in some parts. Tongues of polymorphonuclears are beginning to invade the catgut.

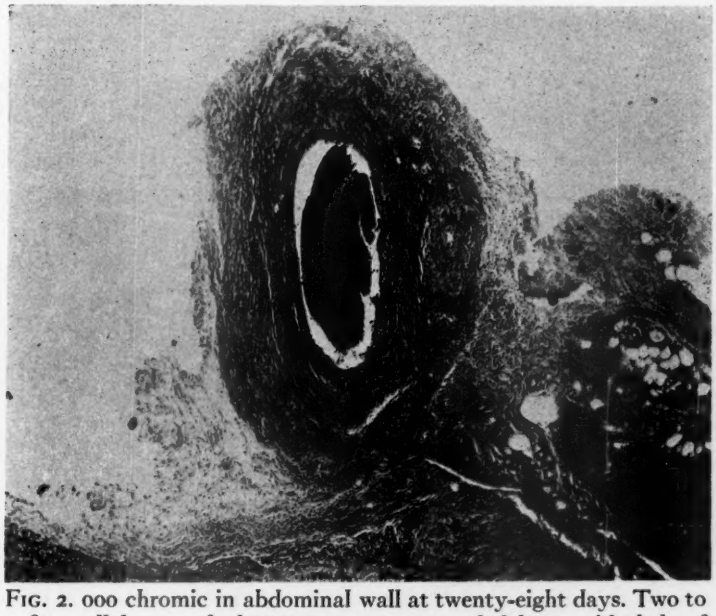

Fig. 2. 000 chromic in abdominal wall at twenty-eight days. Two to five cell layers of phagocytes are surrounded by a wide belt of fibroblasts. The catgut is not more than 30 per cent phagocytized.

(1) amount of exudative reaction or polymorphonuclear infiltration about the catgut (expressed in approximate number of cell layers); (2) the time of appearance and degree of fibroblastic activity (proliferative stage); (3) the degree of phagocytosis of the catgut; and (4) the duration of the catgut in the tissues. Plain and chromic catgut sutures were studied. Size 000 and size 3 were selected to accentuate the results, and size 1* was also used because it is so commonly employed in general surgical procedures.

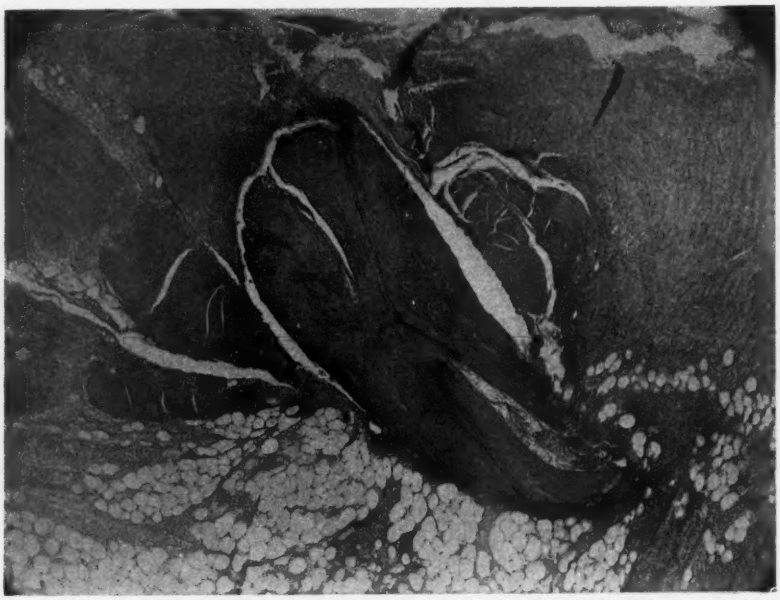

FIG. 3. 3 chromic in fascia for twenty-four hours. This shows how quickly begins the splitting of the large catgut, permitting phagocytosis within, as well as from the periphery.

FIG. 4. 3 chromic in a gastroenterostomy for twenty-eight days. A few polymorphonuclear leucocytes are surrounded by a dense cuff of fibroblasts. The catgut has been split six times, and each has undergone phagocytosis until only one-third of the material remains.

* There is no standard gauge of catgut sizes respected by all suture manufacturers.

Not only were typical wounds provided by making gastroenterostomies, but an opportunity presented itself then to study the comparative rates of wound healing in the intestine and in the abdominal wall. None of the dogs to be discussed had grossly infected abdominal wounds, and the absence of peritonitis served as a check on the condition of the gastroenterostomy wounds. Bacteriologic studies were not done because it is known that bacteriologic *contamination* always exists in the tissue from the skin straight on through to the peritoneum regardless of the method of skin "sterilization."

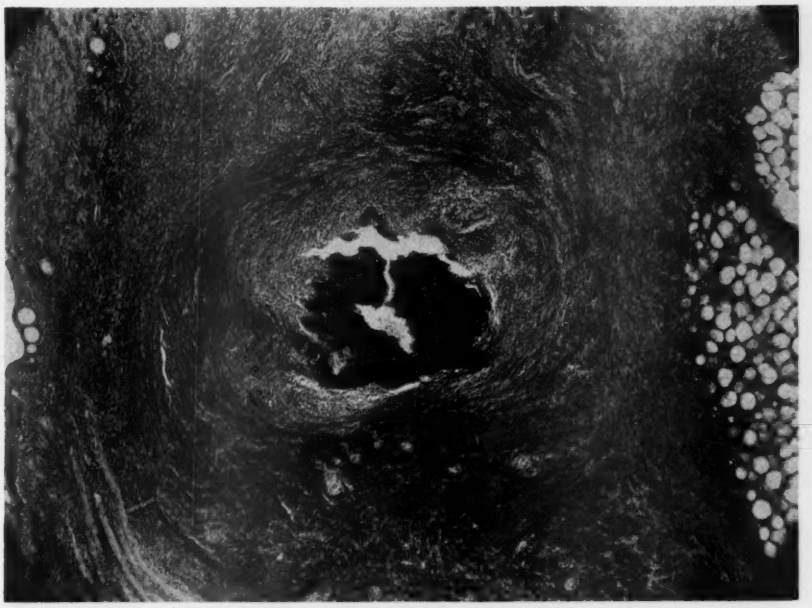

Fig. 5. 1 chromic in fascia for fourteen days. Five to twenty layers of round cells are being surrounded and replaced by an active belt of fibroblasts. The catgut is one-fourth phagocytized.

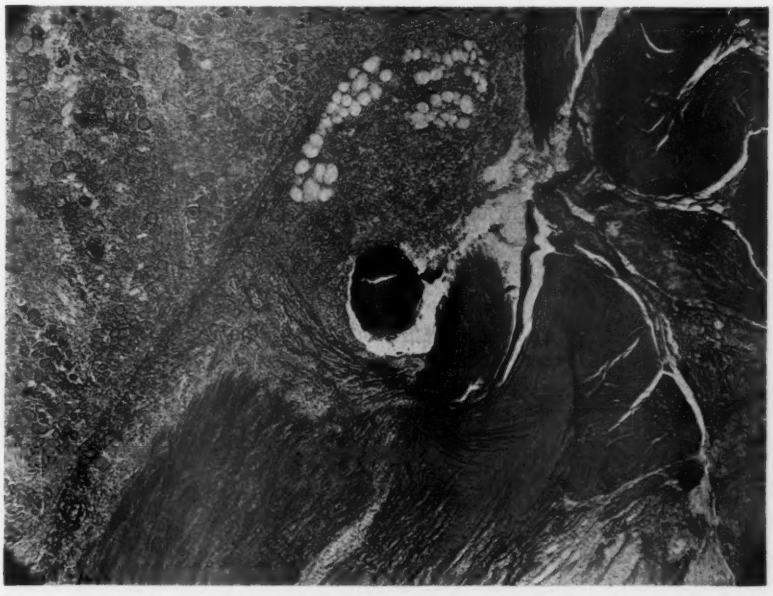

Fig. 6. 000 plain in abdominal wound for four days. There is a very wide zone of round cell infiltration.

1. Employing *chromic* catgut, studies with the 000 suture showed filmy omental adhesion at twenty-four hours. Grossly, a

beginning self support in the wounds was noted at four days. Fibroblasts had appeared by this time and surrounded a

the end of the twenty-eight-day period, about half of the catgut had disappeared. (Figs. 1 and 2.)

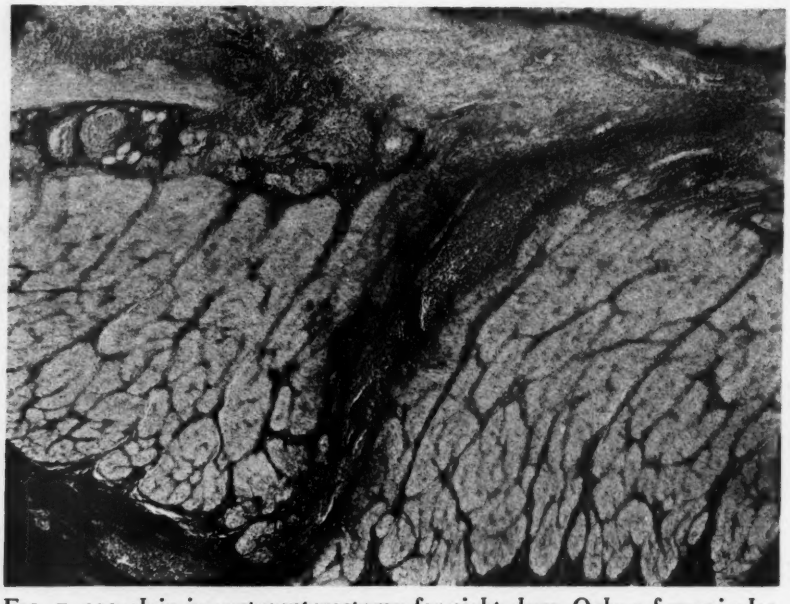

FIG. 7. 000 plain in gastroenterostomy for eight days. Only a few spicules of catgut remain, and these are surrounded by ten to twenty layers of round cells. Fibroblasts have not yet appeared.

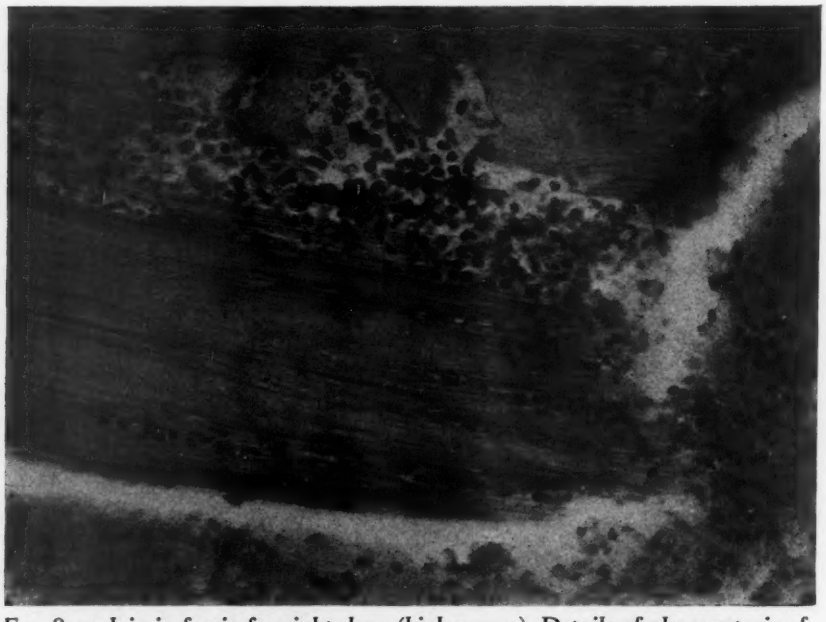

FIG. 8. 3 plain in fascia for eight days (high power). Details of phagocytosis of catgut. Note how it is attacked from within as well as at its periphery.

round cell reaction ten to thirty cells deep from the suture. The catgut demonstrated enough tensile strength to continue functioning for fourteen days in both gastroenterostomies and abdominal wounds. At

2. The size 3 chromic suture was inconstantly associated with adhesions. With it both gastroenterostomy and abdominal wounds healed at about the same rate. At four days, there was no gross healing. Small

green masses of necrotic tissue had collected about the catgut knots. Fibroblasts appeared by this time to begin surrounding

3. The size 1 chromic suture was associated with inconstant peritoneal adhesions. At the four-day period, fibroblasts began to

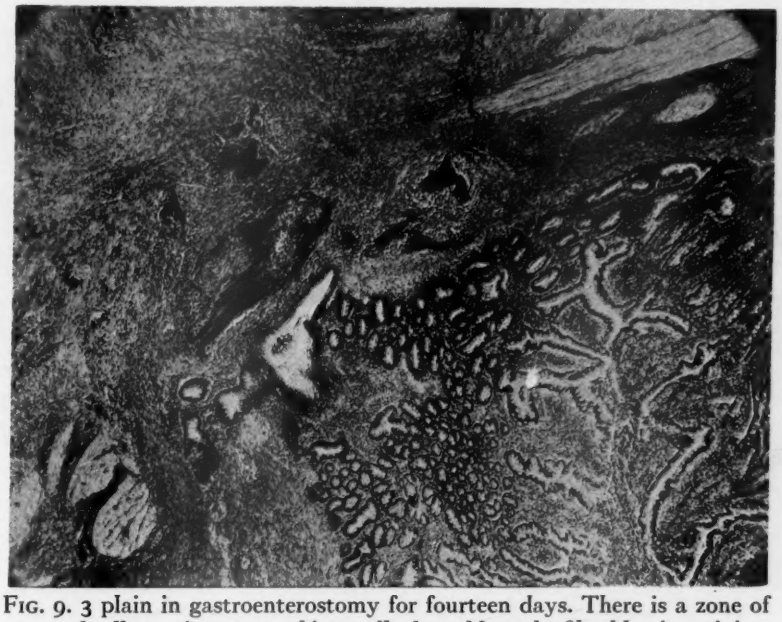

Fig. 9. 3 plain in gastroenterostomy for fourteen days. There is a zone of round cell reaction ten to thirty cells deep. Note the fibroblastic activity. Phagocytosis is about four-fifths completed.

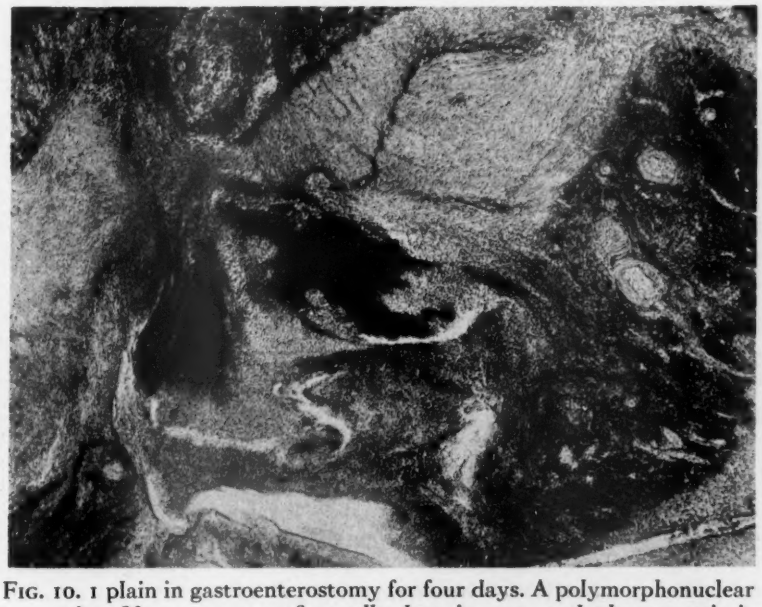

Fig. 10. 1 plain in gastroenterostomy for four days. A polymorphonuclear reaction fifty to seventy-five cells deep is seen, and phagocytosis is already well advanced. There are as yet no fibroblasts.

the five to twenty-five cell layers of polymorphonuclears. At eight days, the poorly healed wounds contained frayed suture, having little, if any, function. At twenty-eight days, the catgut was one-half phagocytized. (Figs. 3 and 4.)

appear in spots outside of the ten to fifty layers of infiltrating round cells. The suture exhibited appreciable tensile strength up to the fourteenth day, after which swelling and fraying reduced it to uselessness; suture particles were present at the twenty-

eighth day. Both abdominal wounds and gastroenterostomies healed at about the same rate. (Fig. 5.)

4. Employing *plain* catgut in similar fashion, some interesting contrasts were observed. The size 000 produced prompt, severe, and persistent gross reaction in both kinds of wounds. At four days, the catgut had lost all holding power, and repeated eviscerations occurred then in the experimental animals. By eight days, the last microscopic traces of catgut were fast disappearing and only then did fibroblasts begin to appear. The gastroenterostomies all held, however, through their critical period. (Figs. 6 and 7.)

5. Size 3 plain in wounds caused much reaction. One dog eviscerated in twenty-four hours, but this complicated a wound infection. At four days, there was no gross healing in either type of wound. The suture was weak, swollen, and one-half gone. At this time round cells 200 deep diffused widely into the deeper structures. Fibroblasts appeared by the eighth day, and by the fourteenth day the catgut had disappeared. Healing occurred at parallel rates in both kinds of wounds, and peritoneal adhesions were found in some cases and not in others. (Figs. 8 and 9.)

6. The more commonly used size 1 plain in both types of wounds was not greatly different from the larger catgut, except that grossly there was somewhat less reaction. The suture functioned no longer than four days, and frayed strands persisted for two weeks. From the first, a wide zone of round cells hastened phagocytosis. The fibroblasts appeared after eight days. (Fig. 10.)

There are certain factors which make for inexactitude in such an experiment: the variations in supposedly comparable catgut made by different concerns; the variations in different lengths of the same strand of material;* the inconstancies of local tissue blood supply; and the differences in the tension with which succeeding sutures are tied. Nevertheless, the results are consistent enough to illustrate some useful points.

That any catgut acts as a foreign body in a wound, and detrimentally affects the power of that wound to heal, is a universally recognized fact. Plain catgut is a much more violent irritant, however, than is chromic catgut—and that is not a universally recognized fact. Regardless of the size of the suture employed, plain catgut resulted in slower healing than chromic. At any day examined, the histologic sections showed a wider zone of round cell infiltration around the plain catgut than around the chromic. True, the larger the plain suture the greater the reaction around it; but there was as much infiltration around the smallest plain suture as around the largest chromic.

If the appearance of fibroblasts be considered a criterion for the beginning of healing—the first stage in scar production—then the time of first appearance of fibroblasts might be of significance in learning which catgut is least deleterious to wound repair. Table 1 indicates a relationship between the size and kind of catgut, and the time of first appearance of the fibroblasts.

Table 1

Type of Suture	Appearance of Fibroblasts, Days
Chromic	
000	4
1	4
3	4
Plain	
000	8–14
1	8–14
3	8–14

The smallest amount of tissue reaction, the earliest appearance of fibroblasts, the most rapidly healing wounds, occurred when using the 000 chromic suture. The most violent reaction, the most retarded appearance of fibroblasts, the wounds which exhibited edema the longest and

* Kraissl. Intrinsic factors altering the absorption of catgut. *Surg. Gynec. & Obst.*, 63: 561, 1936. Fractured strands and foreign inclusion bodies are demonstrated in samples of catgut. Kraissl also believes allergy sometimes makes the catgut suture behave unpredictably.

healed the worst, occurred when using the 3 plain catgut.

All agree that chromic sutures exert holding power longer than plain sutures. But how long each holds and to what extent suture size influences the duration of function are matters not so widely agreed upon. Table II lists these sutures in relation to function—that is, the exhibition of demonstrable holding ability of the catgut when the wound was torn down for examination.

TABLE II

	Days
ooo plain	under 4
3 plain	4
1 plain	4
3 chromic	8
1 chromic	14
ooo chromic	14

The eviscerations that repeatedly occurred on the fourth day when using the ooo plain catgut, while making difficult the completion of the series, were expected because that catgut is so tiny and plain catgut is absorbed so fast. But eviscerations were almost frequent at about the fourth day when using size 3 plain. This was more of a surprise—until it was appreciated that the wounds did not start to heal so soon with plain catgut, especially large plain catgut. The 3 plain let go at four days, just as soon as the smaller sizes did.

The table also indicates that the size 3 chromic catgut did not hold up so long as the size ooo chromic. Figure 3, made at the twenty-four-hour period, shows 3 chromic, partly untwisted, permitting phagocytes within the strand almost at once. Figure 4 shows, at twenty-eight days, the fragments of six islands of catgut, which together represent the cross section of what was once one strand. Working with catgut in artificial media, Kraissl* also came to believe that the large catgut did not necessarily hold longer than the small. Table III, listing the persistence of suture fragments, shows only that, regardless of size, chromic suture becomes a foreign body for more than two weeks after it has ceased to be useful. The small size persisted, presumably because it was thoroughly chromacized, the large by virtue of its excessive mass of chromacized collagen.

TABLE III

PERSISTENCE OF SUTURE FRAGMENTS

		Days
ooo plain	all	absorbed in 8
1 plain	all	absorbed in 14
3 plain	⅘ths	absorbed in 14
ooo chromic	½	absorbed in 28
1 chromic	½	absorbed in 28
3 chromic	½	absorbed in 28

CONCLUSIONS

1. Plain catgut excites a prompt, violent exudative foreign body reaction which delays the appearance of fibroblasts, and so delays wound healing.

2. Large plain catgut is absorbed practically as fast as the smaller sizes, and any size fails to hold throughout the time wound support is needed.

3. Chromic catgut is associated with a retarded and lessened exudative foreign body reaction and with the early appearance of fibroblasts and early healing.

4. Small chromic functions longer than very large chromic catgut.

5. Wound support and healing are most satisfactory when the smallest chromic suture is employed.

* Kraissl. *Op. cit.* " . . . The table shows that the larger sizes do not necessarily last longer than the smaller sizes. The explanation of this may be that the digestive media penetrated between the ribbons and digests each separately. In chromic gut, the chromacizing may be on the outer layer only, and, when this is penetrated, digestion is rapid, while in the smaller sizes the chromacizing extends through the entire strand."

THE VALUE OF PITRESSIN IN ABDOMINAL SURGERY*

WITH SPECIAL REFERENCE TO DOSAGE AND TECHNIQUE

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IN 1932 a preliminary report on the use of pitressin in abdominal surgery was published. In this report we expressed the feeling that the answer to the paralytic ileus problem lay in prevention rather than in the institution of therapeutic measures once this condition had become clinically evident. To this end, surgical pituitrin and later pitressin were employed, the first injection being given before operation so that the drug might act upon a nondistended intestine and hold it in a state of contraction. Subsequent injections were given at regular intervals in order to maintain this contraction and these were continued through what we termed the "atonic period." We reported 200 cases in which this procedure had been carried out. From 1932 to the present, pitressin has been used routinely on the wards of the First Surgical Division of Bellevue Hospital in 2,500 abdominal cases.

The purpose of the present paper is to reëmphasize the principle of prophylaxis in regard to paralytic ileus, to consider briefly the drug that we have been using, to outline in detail our present technique, to discuss certain side reactions which may be encountered, and finally to render an opinion, based upon a considerable series of cases, as to the value of pitressin in abdominal surgery.

The prophylactic use of pitressin was based upon the supposition that if a condition of hypertonia of the small intestine could be produced before operation and maintained during a sufficient postoperative period, the incidence of paralytic ileus would be materially lessened. This is shown graphically in Figure 1.

The Drug. Pitressin is the pressor and antidiuretic principle of the posterior lobe of the pituitary body. This hormone was first isolated (separated from pitocin, the oxytocic principle of the pituitary gland, and from inert proteins) by Dr. Oliver Kamm and his associates. It is standardized to contain 20 pressor units in each cubic centimeter of aqueous solution.

Technique. Based upon the principle of prophylaxis as stated above, a definite technique is essential if satisfactory results are to be obtained and if certain unfortunate results are to be avoided. During this five-year period we have experimented with dosage of the drug, with varying intervals between injections, and with the mode of administration. We have been particularly interested in the cases in which there have been untoward reactions and have attempted to explain these. Since a definite technique has been adopted, our results have improved and there has been less concern over the question of reactions. The routine use of pitressin is now taught at Bellevue as a part of the nursing course and the student nurses are instructed in detail. The important points are as follows:

1. *Dosage.* To be effective in patients over 12 years of age 1 c.c. (20 units) of pitressin must be used. The manufacturer recommends the 10 unit dosage in adult cases, but we have found this to be ineffectual. During 1935, the standardization of the preparation was altered in such a way that 1 c.c. of pitressin contained 10 pressor units instead of the former 20 units. For a period of months this smaller dosage was used routinely. Our results were far from satisfactory. Pitressin is

* From the Department of Surgery of Columbia University, and the First Surgical Division of Bellevue Hospital. Read before the New York Surgical Society, November 10, 1937.

now standardized to contain 20 units per c.c. as originally. It is supplied in 1 c.c. ampules containing 20 units, and in ½ c.c. ampules containing 10 units. To avoid confusion it is at present necessary in ordering the drug to stipulate the number of units desired.

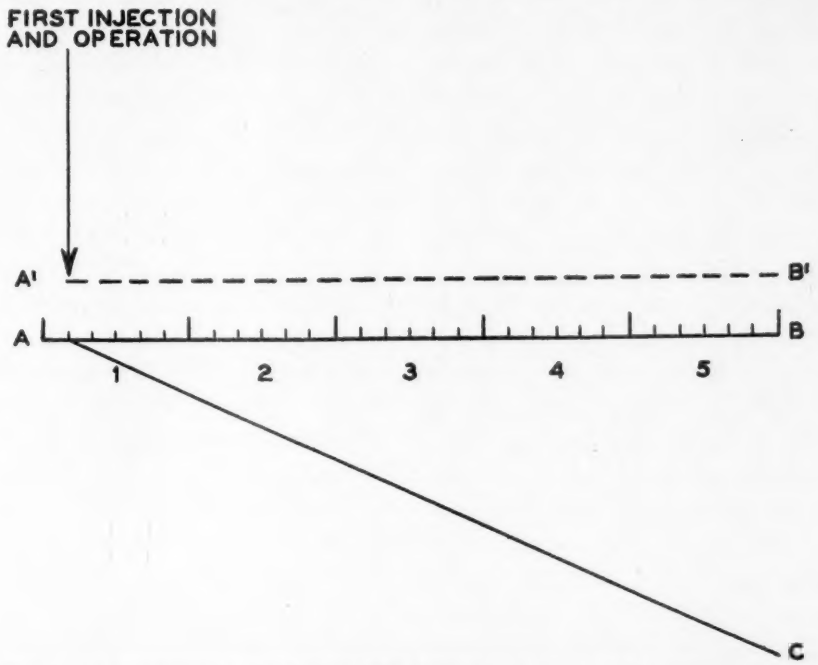

Fig. 1. AB represents normal tone. The figures 1, 2, 3, 4, and 5, represent the days following operation. The solid line AC represents a steady decrease in tone leading to a state of paralytic ileus. The broken line A'B' represents the state of increased tone which we attempt to bring about and to maintain during the first few postoperative days; i.e., during the "atonic period." The small subdivisions represent the periodic administration of the drug.

2. *Time and Frequency of Administration.* Where a general or local anesthetic is to be used, the first dose is given as the patient is placed upon the operating table. Where spinal anesthesia is used, the initial dose is given at the end of the operation, as the constricting action of the anesthetic is in force up to that point. Following operation, pitressin is administered every four hours in uncomplicated cases for ten or twelve doses. Where any degree of peritonitis exists, the interval is two hours instead of four. If pneumonia develops, a two-hour schedule is adopted. Ventral hernia cases are also placed on a two-hour schedule, as these are prone to become distended.

3. *Mode of Administration.* It is essential that pitressin be given intramuscularly. This not only assures the prompt action of the drug, but is a means of avoiding accidents. Nurses are trained to administer drugs by the subcutaneous route and their hesitancy in pushing a long needle deeply into the tissues has been one of the difficulties that we have had to overcome. In giving pitressin a 1½ inch needle is used. The left hand is placed in the axilla with the palm toward the arm and the skin over the deltoid drawn taut, compressing the veins in the subcutaneous tissue, thus avoiding an accidental intravenous injection of the drug. The needle is inserted into the posterior half of the muscle far from the cephalic vein. If the skin is under tension and the needle is inserted rapidly, very little discomfort is experienced by the patient.

Action of Pitressin on the Human Intestine. Much of the antipathy toward the

use of pituitary extract in operative cases and particularly in those with any degree of peritonitis is based upon the assumption that this drug produces an extreme degree of peristalsis. It is argued that in the case of diffuse peritonitis hyperperistalsis is not desirable, as infection may be spread from involved to uninvolved portions of the abdominal cavity. Also, experiments carried out with inflated bags placed in various colostomy or ileostomy openings seem to confirm the view that posterior pituitary extract is a violent peristaltic stimulant.

Our clinical observations do not tend to confirm this view. Where pitressin is administered early in the presence of non-distended intestine and continued at regular intervals, there is seldom any evidence of increased peristalsis. Where it is given before operation and the effects in the open abdomen noted, there is a very gradual shrinking of the small intestine, coming on about twenty minutes after the injection. Sometimes this shrinking is uniform, and sometimes it is segmental in type. We have noted nothing in the nature of violent peristalsis. Again, following operation there are seldom signs to point to any violent degree of activity. Gas pains are seldom complained of and the picture has been that of an unusually quiet abdomen. We have used pitressin at regular intervals following obstructive resection and with a few exceptions, the abdomen has remained flat and the patient without the discomfort which one would expect were hyperperistalsis present. We have found pitressin most useful in our cases of diffuse peritonitis where paralytic ileus plays such an important part in the outcome. In these cases we have observed no evidence of hyperperistalsis, and we have been enabled to maintain a relatively non-distended abdomen.

The action of pitressin on distended intestine is quite different. Here it often produces a violent reaction with the expulsion of colonic contents. Clinically, this effect is one of a rapid, sustained contraction rather than of violent and prolonged peristalsis. In our experience there has been but one instance in which the colon has been emptied on the operating table following the preoperative injection of pitressin. We feel that the results which have been noted experimentally following the insertion of inflated balloons in colostomy and ileostomy openings are analogous to those following the injection of pitressin in the presence of distention, and that these findings do not give a true picture of the action of the drug on non-distended intestine.

Reactions. There *are* reactions following the use of pitressin. Some of these have only to be understood to be dismissed. In the majority of cases there will be noted a blanching of the skin which has been a cause for unjustifiable worry on more than one occasion. This is a normal pituitary reaction, is the result of constriction of the small vessels in the skin, and is not associated with a fall in blood pressure or a change in pulse. This blanching is to be expected and is of no clinical significance. Some patients will vomit after every injection. This is rarely seen, however, and is unimportant. Abdominal cramps will occasionally follow each injection.

There are two types of real shock produced by the administration of pitressin; the first appears to be anaphylactic in nature, follows every injection of the drug, and is characterized by a fall in blood pressure, pallor, a moist skin, and a thready pulse. This may last for from twenty to thirty minutes. We have seen three instances of this type. The second and more common form of shock may follow the third or fourth injection. There is extreme pallor, a marked fall in blood pressure, and a rapid pulse. These symptoms have not followed preceding doses, and they will not in all probability follow subsequent injections of pitressin. We believe that this type of reaction is the result of accidental and rapid intravenous administration of the drug, and this is the reason for our insistence that pitressin be

given into a taut muscle. There have been ten instances of this type of shock and in each instance the rule as to intramuscular injection had not been observed, the needle having been introduced subcutaneously. None of these patients has died nor are we aware of any report in the literature to the effect that a patient has ever died of pituitary shock.

Treatment consists in the intramuscular administration of adrenalin chloride. We do not believe that reactions are the result of the number of units injected, but are due either to an idiosyncrasy on the part of the patient to pituitary extract or more often to the injection of a full dose of pituitary extract into a small vein in the subcutaneous tissue. We have had reactions following the injection of 10 units, and we have given 40 units without reaction.

Pitressin is not always all-sufficient in the prevention and treatment of distention. We have not hesitated to make use of duodenal suction and of colonic irrigations when necessary. However, the number of irrigations ordered during this five-year period has been far smaller than during the five-year period preceding. This has resulted in the need for less nursing care.

In the bibliography there will be found reference to articles which have appeared during the past ten years. These deal with pitressin rather than with pituitary extracts in general. In a carefully written paper, W. D. Frazier of the Hospital of the University of Pennsylvania and the Harrison Department of Surgical Research has furnished an historical outline of the development of posterior pituitary therapy, a complete bibliography, and has given his opinion as to the value of pitressin in the prevention and relief of adynamic ileus.

CONCLUSIONS

After considerable experience in the routine prophylactic use of pitressin during the past five years, both on the wards and in private practice, we feel that this preparation is a most valuable addition to the equipment of the abdominal surgeon. The fears which have for many years attended the administration of posterior pituitary extract, particularly in cases of diffuse peritonitis, have been shown to be groundless. It has been our experience that in this type of case above all others, pitressin has proved its worth. The drug has been standardized and is surprisingly uniform in its action. However, for the attainment of optimum results and the avoidance of untoward reactions, a definite technique must be adhered to.

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ACUTE AND CHRONIC CICATRIZING ENTERITIS (REGIONAL ILEITIS)

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THE term regional ileitis was first used by Crohn et al.[1] to describe a condition of non-specific inflammatory disease occurring in the distal portion of the ileum. Subsequently, with more widespread recognition of the condition, a variety of names have been given to this process. Erb and Farmer[2] describe their cases under the caption ileocolitis; Meyer and Rosi[3] under the title regional enteritis (non-specific); Galambos and Mittelmann[4] as terminal ileitis; antedating all of them are the old terms, infectious granuloma and sarcoid.

Etiology. Regional ileitis is most frequent in young adults, but it has been reported in patients of various ages. Koster, Kosman and Sheinfeld,[5] in a detailed review, noted its occurrence in each of the first seven decades. Early reports[1] indicated a ratio of two males to one female, but of the seventeen cases reported by Koster et al.,[5] combined with the sixty-two cases in which the sex was mentioned, which they collected from the literature, there were forty-four males and thirty-five females, not a significant difference. Occupation does not appear to be a factor. Crohn, Ginzburg and Oppenheimer[1] noted that members of the Hebrew race appeared to be more susceptible than others, and their observation has been confirmed in subsequent reports. However, Bargen and Dixon[6] failed to note a prevalence of Jews among the numerous cases of regional ileitis observed at the Mayo Clinic.

Although the condition appears to be definitely infectious, various cultural methods, animal inoculations, immunologic procedures and detailed histologic studies have failed to reveal a specific etiologic infectious agent. Felsen's investigations,[7,8,9] indicating that the condition is initiated by acute bacillary dysentery, are an exception to this statement. He obtained positive agglutination titers against organisms of the Eberthella dysenteri group (Sonné-Duval type, especially) in sixty-two consecutive cases of chronic ulcerative colitis, in fourteen cases of chronic distal ileitis, and in two cases of non-specific ileocecal granuloma. Diagnostic bacteriophage reactions and positive fecal cultures for dysentery bacilli were obtained in some of the cases. Control studies of 300 blood sera resulted in 4.6 per cent positive agglutination reactions with E. dysenteri. Acute distal ileitis was observed in fourteen cases of acute bacillary dysentery. Felsen concluded that dysentery in this atypical form at times progressed into a chronic phase and with the aid of secondary non-specific infection resulted in "regional ileitis." In discussing the paper, "A Combined Form of Ileitis and Colitis," presented by Crohn and Rosenak[10] at the 1935 session of the American Medical Association, Felsen stated that "chronic non-specific ulcerative colitis and distal (regional) ileitis, either alone or as associated lesions, and non-specific ileocecal granuloma are all manifestations of bacillary dysentery." Crohn replied that careful

studies of the cases of regional ileitis observed at the Mount Sinai Hospital failed to substantiate this view. The majority of the authors reporting this condition appear to have had similar difficulties in proving a B. dysentery etiology.

Koster et al.,[5] observing a certain similarity of regional ileitis to lymphogranuloma inguinale, applied the Frei test to six of their cases but with uniformly negative results. Mock[11] has reported a number of cases of "infective granuloma" of various levels of the gastrointestinal tract including lesions of the "regional ileitis" type. He attributed the conditions to various non-specific factors, such as appendicitis, foreign bodies, ulcers, extra peritoneal infections, trauma and so forth, and stated that the "condition is directly due to low grade infection causing an impairment of circulation or to an impairment of circulation followed by low grade infection."

Barbour and Stokes[12] suggested that a chronic recurrent intussusception might initiate the process by impairing the circulation and vitality of the gut wall and allowing bacterial invasion from the lumen.

Several authors have submitted statistics indicating that about 50 per cent of these patients previously have had an appendectomy. Obviously, appendectomy in itself would not be an etiologic factor although early symptoms of ileitis are frequently mistaken for appendicitis. Homans and Hass[13] suggest an association between appendicitis and ileitis, stating that in both of their cases there was definite evidence of disease of the appendix. Mixter,[14] among others, expresses himself as opposed to any such relationship.

We must conclude that the exact etiology and pathogenesis of regional ileitis has not been determined; that it appears to be a non-specific inflammatory process initiated perhaps by a variety of factors and aggravated by various constituents, bacterial and otherwise, of the intestinal content.

The *pathology* of regional ileitis is that of a progressive non-specific proliferative inflammatory process.[5,15] In the early phase the involved segment of bowel and its mesentery are edematous and congested. The muscle fibers of the bowel wall are separated by edema, and moderate diffuse leucocytic infiltration is present. Focal hemorrhages occur, particularly near the serosa. There is a hyperplasia of lymphoid tissue in the submucosa and in the adjacent mesenteric nodes. The mucosa along the mesenteric attachment of the gut exhibits longitudinal ulcers. The valvulae conniventes are blunted and indistinct, depending upon the degree of edema.

As the process progresses, the mucosal ulcers extend into the wall and fistulae may form. These often end blindly in the attached mesentery, but, at times, they communicate with another viscus or drain externally. Generalized peritonitis is usually prevented by extensive adhesions. Foci of necrosis with abscess formation are found in the bowel wall and the mesentery. The central part of these foci shows many neutrophiles, endothelial leucocytes and foreign body giant cells, and toward the periphery lymphocytes and plasma cells predominate. Occasionally particles of foreign material, presumably from the lumen of the intestine,[15] are demonstrable. Small foci of inflammation superficially resembling tubercles may be present just beneath the serosa.

Coexistent with the injury and destruction of tissue, there is marked proliferation and repair. Granulation tissue forms at the sites of the ulcers and abscesses, and dense fibrosis of the intestinal wall and adjacent mesentery occurs. Regenerated simple columnar epithelium may cover the ulcerated areas, resulting in a flattened, smooth epithelial surface with no evidence of mucosal folds. In other areas edematous valvulae conniventes form sessile polypi. Eventually, stenosis of the bowel occurs, and the proximal intestine dilates and hypertrophies. Originally, the lesion was believed to include only the terminal ileum, beginning at the ileocecal valve and progressing proximally for 25 to 35 cm. in the ileum.[1] It is now recognized that a non-

specific chronic inflammatory process of this type may involve any part of the intestinal tract.[5, 10, 11, 13, 15, 16, 17]

FIG. 1. Case I. *X*-ray taken six hours after oral barium sulfate. Note typical string sign, representing the terminal ileum and dilatation of proximal ileum.

Symptoms. The symptoms of regional ileitis vary with the location of the process in the intestinal tract, its acuteness or chronicity, the duration and extent of the lesion and the presence or absence of complications such as abscesses, fistulae, etc. In the large majority of reported cases the history of the illness is measured by years, ten or more not being unusual. As most commonly the lesion is located in the distal ileum, the majority of symptoms and signs are referred to the right lower quadrant of the abdomen.

Crohn et al.[1] have divided the symptoms into four groups. In Group I the symptoms resemble those of acute appendicitis, with pain and tenderness in the right lower quadrant, fever and vomiting, although the onset is usually somewhat slower than that of typical acute appendicitis. Nevertheless, that many of the early acute cases are mistaken for appendicitis both pre- and postoperatively is attested by the reports in the literature. The postoperative development of obstructive symptoms or persistence of fistulae finally has indicated the correct diagnosis. It is easy to understand that if an abscess about the cecum is drained, with minimum disturbance of the intestines, detection of the basic process may be missed. Meyer and Rosi[16] reported such an instance in which the persistence of a fistula following drainage of an abscess led to further study. On the other hand, where operation discloses "chronic appendicitis" in a patient who presents symptoms suggesting an acute process, it is difficult to understand how a competent surgeon should miss the real pathology.

Group II includes those cases presenting symptoms of ulcerative enteritis. There is a history of colicky abdominal pain, frequent stools with mucus and sometimes blood. There is also loss of weight and secondary anemia. Repeated stool and proctoscopic studies show nothing definite. Often these patients have a history lasting for years. Galambos and Mittlemann[4] reported a case of this type, the patient having suffered with diarrhea and pain for fifteen years; the persistence of a fistula following appendectomy finally attracted attention to the underlying condition.

Group III comprises those cases with obstructive symptoms which usually occur late in the course of the disease, but in some instances appear suddenly without previous complaints. The symptoms are generally those of an incomplete obstruction of the small intestine. There are cramps, pain, borborygmi, distention and perhaps nausea and vomiting. Often there is a history of recurring attacks of diarrhea.

In Group IV are those cases with fistulae. The fistulae may be of the external type and follow exploration and drainage or they may be of the internal type with a fistulous tract connecting the ileum with the colon or sigmoid. Symptoms occurring in this group of cases vary greatly, but commonly there are diarrhea, loss of weight, anemia and abdominal cramps. There may be intervals of fever during periods of activity.

Individual symptoms occurring in the course of the disease warrant further discussion. Abdominal pain seems to be the most outstanding symptom. It is usually of a colicky or cramp-like type and is more commonly located in the lower right quadrant, although it may be diffuse. It may be dull, and it is often relieved by defecation. In the presence of abscesses or fistulae, naturally the pain will be of a different type and location. In some instances, the pain is acute and severe, similar to that seen in appendicitis. Careful review of the reported cases shows a record of pain in nearly every one and the recurring descriptive terms 'colicky' or 'cramp-like' are significant.

Diarrhea is also a common symptom although by no means so constant as pain. Usually there is a history of from four to six soft stools per day. It is uncommon to obtain a history of many movements although Homans and Hass[13] reported the case of a patient who had twenty to thirty stools daily over a period of six years. Occasionally mucus appears in the stools, but blood is a rare finding. Diarrhea is absent in about one-third of the reported cases.

Nausea and vomiting are relatively infrequent symptoms. However, there is often a history of indigestion and eructation of gas.

Fig. 2. Case 1. Muscularis of terminal ileum. (×62.) Note separation of smooth muscle fibers by edema and diffuse leucocytic infiltration.

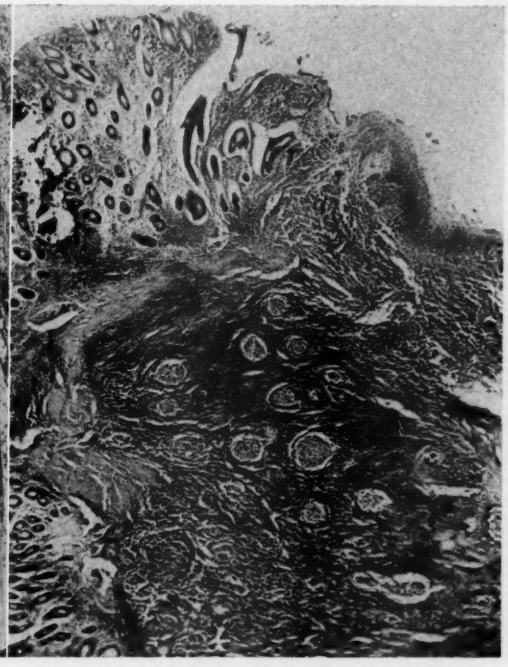

Fig. 3. Case 1. Acute ulcer of terminal ileum. (×62.) Observe fibrinopurulent exudate on ulcer base and marked hyperplasia of lymphoid tissue of Peyer's patch.

Fever is a variable factor. High temperatures are uncommon except in the acute type of case or with the development of complications. A moderate fever of 99 to 102 degrees is present in about 35 per cent of the cases, and periods of fever followed by apyretic intervals are often observed. Loss of weight is commonly noted, varying from a few pounds to 20 or 30. At times, these patients become markedly emaciated and dehydrated. Secondary anemia is an almost constant finding, the degree depending upon the extent and duration of the disease. Leucocytosis is the rule, with a count of about 14,000, although normal leucocyte counts are not infrequent.

The abdominal findings are quite constant. Usually there is moderate distention of the abdomen. Rigidity is absent except in the complicated case. Often there is an

area of tympany due to dilated gut proximal to the lesion. In at least 50 per cent of the reported cases, a mass is palpable. Usually the mass is located in the lower right quadrant, although it may be in the mid-abdomen. It is tender, rather firm, somewhat irregular in outline and slightly mobile. The size varies from 10 to 40 cm. in length and 5 to 10 cm. in width. In some instances the mass may be palpated through the rectum or vagina. Where partial obstruction exists, peristaltic waves are occasionally visible and audible.

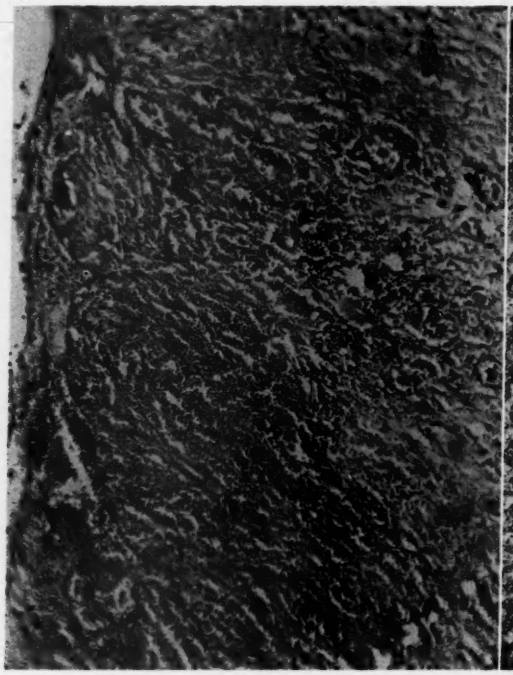

FIG. 4. Case 1. Serosa of terminal ileum. (×140.) Observe extravasated closely packed erythrocytes in subserosal adipose tissue with smaller hemorrhages on serosal surface.

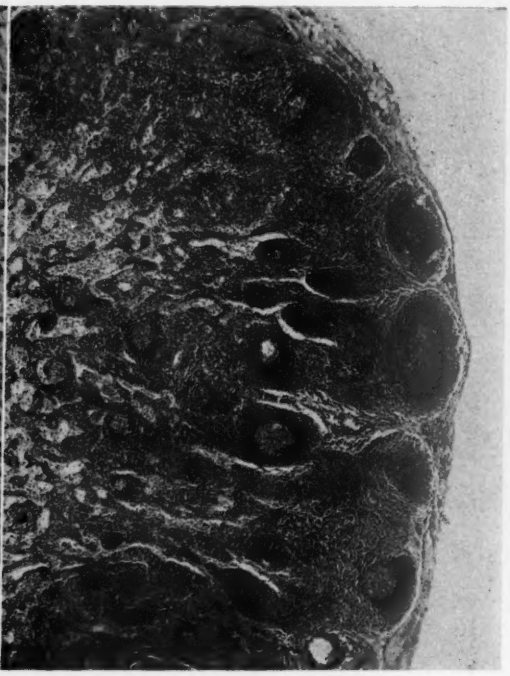

FIG. 5. Case 1. Lymph node from iliac mesentery. (×28.) Germinal centers are enlarged and hyperplastic, sinusoids dilated and filled with exudate.

Diagnosis. Roentgenology is of considerable assistance in diagnosing this condition. Crohn and his associates[1] discussed the findings in their original report, and Kantor[18] has described the Roentgen signs in detail. According to him, the oral contrast medium is likely to demonstrate one or more of the following: (1) a filling defect of the ileum (or colon), the size depending upon the extent of the lesion; (2) an area of tapering off immediately proximal to the defect, rather than a sharp change; (3) dilatation of the gut proximal to the lesion with or without a demonstrable fluid level; (4) the string sign in which a thin linear shadow resembling cotton string extends through the obstruction. Barium enema alone is of little value in most cases as it fails to show the lesion.

Regional ileitis is to be differentiated from ulcerative colitis. This can usually be accomplished by proctoscopic examination and a barium enema which will be negative in the former and positive in the latter condition. The history and physical examination, especially of the chest, along with gastrointestinal *x*-rays will assist in ruling out tuberculous lesions of the intestine. Differentiation from acute appendicitis can usually be made by the clinical findings, although careful examination of the abdomen at operation may be necessary. Great assistance can be obtained from the roentgenologist in ruling out actinomycosis and neoplasms of this region. Finally the condition may be confused with so called "idiopathic spastic enteritis." Usually the symptoms in spastic enteritis are

less marked and are transitory; the roentgenogram is quite different also.

The mortality rate of regional ileitis varies with the severity of the process, its duration, magnitude of any operative procedures, etc. Accordingly from the literature one may gather very high as well as low mortality statistics. Binney[17] reviewed twenty-six cases with only one death in the series; Mixter,[14] on the other hand, reported eleven cases with a mortality rate of 36 per cent. A review of a considerably larger number of cases by the present writers discloses a mortality rate of about 12 per cent. It should be noted that recurrences following incomplete eradication of the process are quite frequent.

The *treatment* of regional ileitis depends upon the extent of the disease and the condition of the patient. Meyer and Rosi[16] limited themselves to exploration and appendectomy in three of their eight cases; and careful observation over long periods revealed no further evidence of the disease. These authors suggest that when the edema is limited to the intestinal wall, infection is localized to this region and probably will resolve spontaneously. If thickening of the mesentery and hyperplasia of the neighboring lymph nodes exist, however, this indicates a spread of the infection and makes more radical procedures necessary. Likewise, Probstein and Gruenfeld[19] reported three cases in which the operative procedures consisted of appendectomy with ileostomy; and the ultimate results were satisfactory.

Fig. 6. Case 11. Roentgenogram of colon following barium sulfate enema. Observe low position of right half of transverse colon and compare concavity of its inferior margin with diagram of operative findings in Figure 8.

Fig. 7. Case 11. Roentgenogram, six hours after oral barium sulfate. Narrowing of distal 8 cm. of ileum and obliteration of mucosal pattern. Large opaque mass in midline represents dilated proximal ileum.

We must be cautious in our appraisal of such conservative treatment, for up to the present, insufficient clinical material is available to warrant final conclusions. We do know that recurrences are moderately frequent even after resection.

If abscesses exist, these must be drained before any further surgery is contemplated. When there is considerable stenosis of gut, resection is indicated if the patient's condition will permit. In some instances, an ileocolostomy seems to afford permanent relief, but usually this procedure is con-

sidered a temporary measure to be followed by resection when the patient's condition is sufficiently good. Meyer and Rosi[16] point out that simple ileocolostomy is followed by recurrence in at least 50 per cent of cases. When resection is done, the line of excision must be well away from diseased tissue, for recurrences are considered to be the result of leaving behind involved areas. Fistulae have to be treated by resection of the tract and excision of the area of the gut involved; perhaps resection may be indicated. Transfusion has found favor as a means of preparing many of these patients for operation.

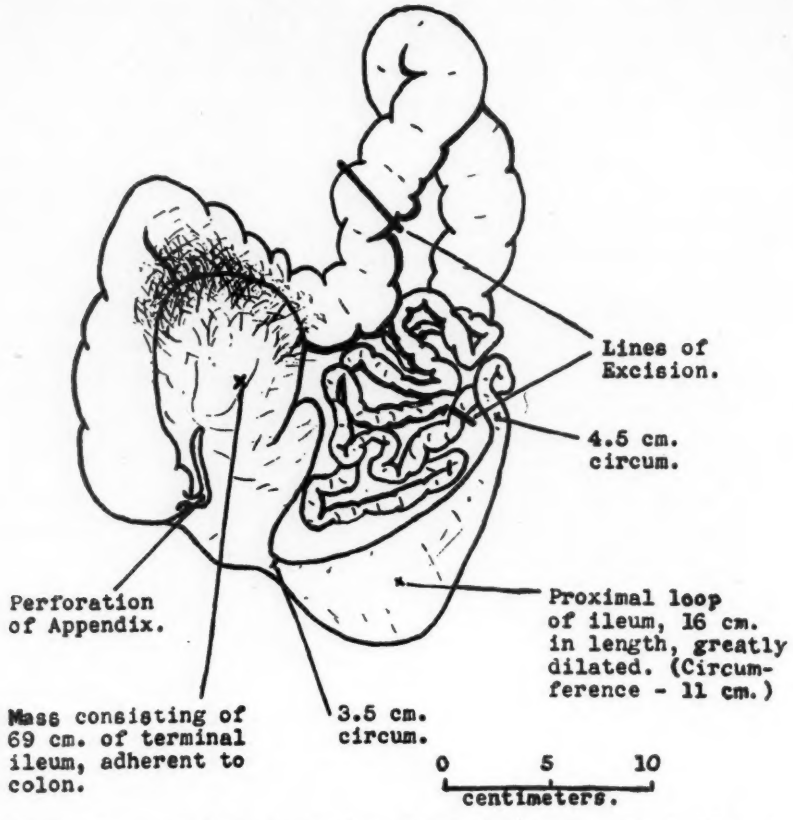
Lines of Excision.
4.5 cm. circum.
Proximal loop of ileum, 16 cm. in length, greatly dilated. (Circumference - 11 cm.)
Perforation of Appendix.
Mass consisting of 69 cm. of terminal ileum, adherent to colon.
3.5 cm. circum.
0 5 10
centimeters.

Fig. 8. Case II. Schematic drawing of operative findings. Excised bowel consisted of 98 cm. of ileum attached to 26 cm. of large intestine.

We present the following two cases to illustrate the clinical and pathologic findings of the acute and chronic phases of regional ileitis.

Case I. A young, male Hebrew twenty-two years of age was first admitted to St. Peter's Hospital in December 1935, complaining of pain in the right lower quadrant. The pain was steady and accompanied by nausea and vomiting. The patient had noticed a gradually increasing constipation over a period of six months before entrance into the hospital. The family history and past history were negative except for several similar attacks during the past year, always relieved by rest and hot packs. There was no diarrhea nor loss of weight.

The physical examination revealed a rather thin, young male adult apparently in some pain. Heart and lungs were negative. There was definite tenderness over McBurney's point in the right lower quadrant. No masses were palpable, nor was there any marked rigidity. The temperature was 99.2°F., the pulse 88 and respirations 20. Blood count revealed 22,000 leucocytes per c. mm. with 90 per cent polymorphonuclears and 10 per cent lymphocytes. Wassermann examination was negative, as reported later.

The patient was operated upon about four hours after admission, the preoperative diagnosis being acute exacerbation of a chronic

appendicitis. A lower right rectus incision was made and opening of the peritoneal cavity disclosed a small amount of free fluid. The appendix was delivered and found to be slightly swollen and edematous, but not apparently acutely inflamed. Further exploration showed some edema and thickening of the terminal portion of the ileum, which was regarded at the time as no doubt secondary to the appendix. We considered that this would subside following the appendectomy. The patient's convalescence was uneventful, the wound healing by primary union, and he was discharged as cured on the eleventh postoperative day. He was eating well, his bowels were regular, and he complained of no pain. The pathologic report was chronic obliterative and acute appendicitis.

The patient was home for ten days, and during this time he began to complain of vague, transient abdominal pain beginning in the region of the umbilicus and radiating in all directions. The pain was not constant, but was fairly sharp when present. Some belching of gas and constipation were also present. There was no nausea nor vomiting.

He reëntered the hospital, this time on the medical service. The temperature on admission was normal, but varied between 99 and 100 degrees during his stay in the hospital. The pulse varied between 72 and 84. Barium enema revealed a fixation and distortion of the cecum, apparently the result of adhesions from the previous operation. There seemed to be considerable spasm about the cecum. The patient was put on atropine, and this plus rest in bed brought about marked improvement. He was discharged as cured after eight days. The diagnosis was postoperative adhesions and spasm.

However, after about two months at home, he was again admitted to the hospital on March 5, 1936. During the interval he had lost considerable weight and strength. Intermittent pain in the right lower quadrant had recurred in association with nausea and vomiting. For one week before admission he had been unable to retain anything except fluids, and these only in small amounts. Constipation had become more and more severe. Physical examination at this time showed a somewhat emaciated, highly nervous, young male adult. Temperature was 99.2°F., pulse 88 and respirations 20. There were definite tenderness and muscle spasm in the right lower quadrant, but no masses were palpable. Examination otherwise was negative. The urine was negative; blood sugar was 80 mg. per 100 c.c. of blood; N.P.N. 36.6; urea N. 15.3; chlorides 433; hemoglobin 70 per cent; erythrocytes 4,256,000 per c. mm.; leucocytes 14,000 per c. mm. with 80 per cent neutrophiles and 20 per cent lymphocytes.

Under hot packs and rest in bed the temperature returned to normal, the bowels started moving, and the patient felt considerably better. A gastrointestinal series was done by Dr. I. J. Murnane, roentgenologist, and revealed the typical string sign of terminal ileitis. (Fig. 1.) A diagnosis of this condition was made, and after an attempt to get the patient in as good condition as possible, operation was done.

The terminal 10 to 15 cm. of the ileum and the cecum made up a large mass of acutely inflamed tissue bound closely together with old and fresh adhesions. The mass in some respects resembled a neoplasm. Resection was done and lateral anastomosis performed between the transverse colon and the ileum. The patient's condition was poor and his postoperative course was steadily downhill despite intravenous therapy, etc. Death occurred on the third postoperative day.

Pathologic description of the excised intestine follows:

Grossly, the specimen consisted of a segment of terminal ileum measuring 24 cm., with a portion of the cecum and ascending colon measuring 14 cm. The proximal 7 cm. of the ileum showed a relatively normal mucosa, although the serosal surface over part of this area was congested and granular. From this point to the ileocecal valve, the wall of the ileum became progressively thickened, measuring 1.1 cm. in thickness near the cecum. The most marked thickening was near the mesenteric attachment. The valvulae conniventes became gradually more edematous and blunted toward the ileocecal valve, and were unrecognizable in the terminal 12 cm., where the mucosa showed edematous rounded elevations. An ulcerated groove 1.5 cm. in width extended along the mesenteric attachment of the distal 12 cm. of ileum. Oral to this for 5 cm., there were patches of mucosa at the mesentery with longitudinal acute ulcerations. Small mucosal ulcers were distributed irregularly at points away from the mesenteric attachment. Al-

though the mesentery of the ileum had been cut close to the bowel attachment, a few enlarged hyperplastic lymph nodes could be observed in the remaining indurated, thickened mesentery. The serosal surface showed hemorrhage, while the mucosa of the cecum revealed an irregular ulcer 4 cm. in greatest diameter. The inflammatory process was, however, very much less marked here than in the ileum. The wall of the cecum, which was thinner than that of the terminal ileum, measured 0.6 cm. at its thickest point. Its serosa was congested and roughened by fatty fibrous tags. Several hyperplastic lymph nodes were attached. The appendix was absent.

Microscopic examination of sections through the terminal ileum disclosed edema throughout the wall. (Fig. 2.) In places the mucosa was ulcerated, with the denuded areas showing young granulation tissue containing many thin-walled capillaries and heavily infiltrated with leucocytes, the majority of them neutrophiles. (Fig. 3.) Recent focal hemorrhages were evident beneath the serosa (Fig. 4) and in the submucosa. The wall was diffusely infiltrated with leucocytes, including lymphocytes, plasma cells, neutrophiles, eosinophiles and occasional giant cells. Scattered dense accumulations of neutrophiles were observed in the iliac wall and the mesentery.

The mesentery showed diffuse fibrosis with intermingled areas of fat. Edema, focal hemorrhages and small abscesses were observed, and occasional foreign body giant cells were present in the abscesses. Many of the small arterioles, capillaries, and veins in the serosa and mesentery were acutely inflamed, while the mesenteric lymph nodes were hyperplastic and acutely inflamed. (Fig. 5.)

Sections through the ulcer in the cecum indicated that the base was covered with young vascular granulation tissue heavily infiltrated with leucocytes. The muscle was edematous and infiltrated with moderate numbers of leucocytes. There were collections of lymphocytes beneath the serosa.

The final diagnosis was acute and chronic ulcerative ileitis and typhlitis, with acute hyperplastic lymphadenitis, most prominent in the terminal ileum.

Case II. A male Hebrew, age 24, entered the Memorial Hospital February 27, 1936 with complaints of diarrhea, loss of weight and weakness, of several years' standing.

According to his parents, his infancy and early childhood had been uneventful; he had grown normally and seemed entirely well. At age 14, he had had an intestinal infection, characterized by diarrhea and loss of weight. From then on, he continued to have similar attacks every two to three weeks, each lasting one to two days. No blood or mucus was noted. At age 14 he weighed 98 pounds, and at 20, 84 pounds. His appetite had always been fairly good. There had been no nausea or vomiting, but of late he had had considerable flatulence. Six weeks previous to admission, the patient suffered with an infectious process followed by jaundice, subsequently proved to be the result of cholelithiasis. At the age of 21, the patient was graduated from an excellent engineering college, but found himself physically unable to follow regular employment.

Examination of the patient upon admission revealed a small, asthenic, pallid male who weighed 75 pounds and was 5 feet 1 inch in height. His skin was slightly yellow, dry and parchment-like due to a minimum of subcutaneous fat. The head was negative except for prominence of the frontal bones which was a family characteristic. The mucous membranes of the mouth were of normal color; there was a hard tumor mass, 2 cm. by 1 cm., located in the center of the hard palate. The teeth exhibited several cavities. The neck was essentially negative. The chest was of the asthenic type with narrow apices and prominent ribs. The heart and lungs appeared normal. The abdomen was soft and flat with a very slight panniculus. The liver dulness was increased to 2 cm. below the costal margin, but its edge was smooth and not tender. The spleen was not enlarged. No free fluid could be demonstrated. In the right lower quadrant of the abdomen, a movable and moderately tender mass about 15 cm. in greatest diameter was visible and palpable, and an unusual, tympanitic area, suggestive of a loop of dilated bowel, was noted to the left of the mass. Rectal examination was negative. The temperature was 98°F., the pulse 80, and the blood pressure 110 systolic and 80 diastolic.

The urine exhibited no abnormalities. Study of the blood revealed the following: erythrocytes 4,040,000 per c.mm.; hemoglobin 14 Gm. (96 per cent Hellige); leucocytes 8,160 per c.mm. with 70 per cent neutrophiles, 25 per cent small lymphocytes, 4 per cent endothelial cells

and 1 per cent eosinophiles; Wassermann reaction negative; non-protein nitrogen 35.5 mg.; creatinine 1.22 mg.; sugar 74.1 mg.; chlorides 472 mg.; calcium 11.3 mg.; cholesterol 104 mg.; icteric index 21.6. Agglutination tests for B. typhosus, paratyphosus A, paratyphosus B and B. abortus were negative. Examination of stools failed to reveal ova or parasites and stool cultures yielded no significant organisms.

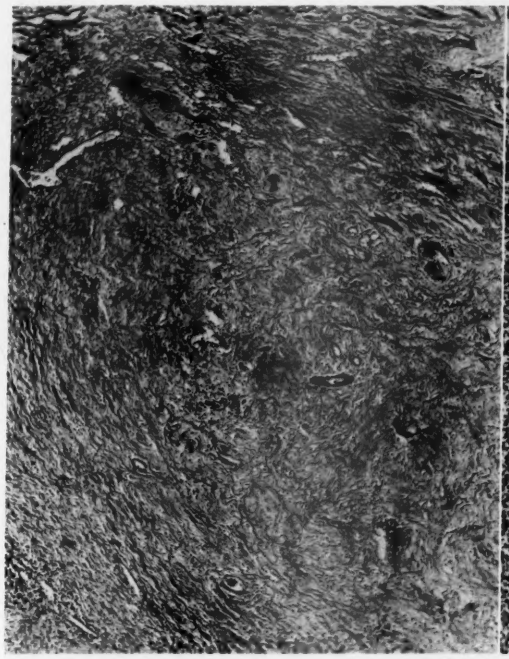

Fig. 9. Case 11. Densely scarred muscularis of terminal ileum. (×62.) Note dense snarl of collagen fibers, moderately infiltrated with leucocytes, replacing smooth muscle layer.

Fig. 10. Case 11. Muscularis of terminal ileum. (×140.) Granulation tissue densely infiltrated with plasma cells, lymphocytes, neutrophiles, eosinophiles and occasional foreign body giant cells. A few fragmented smooth muscle bundles remain.

Radiographs of the gall-bladder revealed poor concentration of the dye and showed many shadows resembling calculi. Barium enema filled the large bowel completely. The right half of the transverse colon was low and its inferior margin presented a concavity suggesting pressure from an extrinsic mass. There was some smoothing out of the descending colon and sigmoid. (Fig. 6.) Barium meal showed the eosophagus and stomach to be normal. At six hours, the stomach was empty and the head of the column was at the cecum. There was a definite narrowing of the distal 8 cm. of the ileum with obliteration of the normal mucosal pattern. The lumen of this portion of the ileum measured 5 mm. in diameter. Proximal to this was a large dense shadow apparently due to dilated loops of ileum. (Fig. 7.) The roentgenologist, Dr. C. Carter Hamilton, reported a diagnosis of regional ileitis.

On March 2, 1936, under avertin ether anesthesia, the abdomen was opened through a 5 inch right paramedian incision. No increase of free fluid was noted. Occupying the lower right portion of the abdomen was a conglomerate mass of intestine adherent to the posterior peritoneum and to the greater omentum. After the latter was dissected off, the details became evident. In places the mass was hard and nodular. It was almost impossible to differentiate afferent and efferent loops, but included in the mass were a segment of distal ileum, the cecum, the ascending colon and part of the transverse colon. There were many palpable glands in the mesentery. The ileum proximal to the mass was dilated. (Fig. 8.) A resection of the distal 100 cm. of the ileum with the cecum, ascending colon and proximal half of the transverse colon was then done. An end to end anastomosis was established and tube enterostomy made above the site of union. The tube was brought out through a stab wound of the right loin and the abdominal wall was closed in layers without drainage. At the con-

clusion of operation, the patient was given 500 c.c. of citrated blood. This was followed by continuous intravenous administration of 5 per cent glucose in normal saline at the rate of 3,000 c.c. in twenty-four hours.

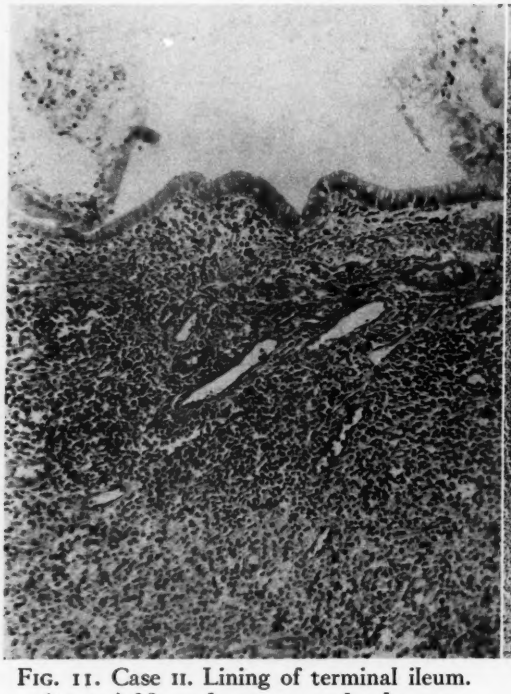

Fig. 11. Case 11. Lining of terminal ileum. (×140.) Normal mucosa and submucosa are absent. Regenerated simple columnar epithelium covers chronic granulation tissue.

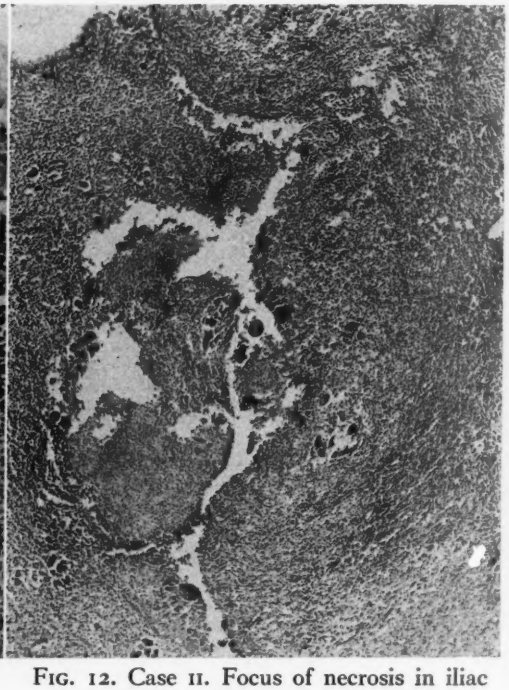

Fig. 12. Case 11. Focus of necrosis in iliac mesentery. (×62.) Central necrosis with numerous foreign body giant cells, endothelial leucocytes, lymphocytes and plasma cells. Outer zone of fibrosis. Resemblance to tubercle formation is slight.

The postoperative course was not remarkable. Two days after operation, the enterostomy tube commenced to drain and auscultation revealed feeble peristaltic sounds. The abdomen was soft. The temperature went to 101°F. and the pulse to 110. Early on the morning of the third postoperative day, the patient had a spontaneous bowel movement. He was then allowed water by mouth in small amounts. On the fourth postoperative day, the abdomen was flat and the patient had two more spontaneous liquid stools. On the seventh day the enterostomy tube came out. Two days later the sutures were removed and the wound healed by primary intention. On the eleventh postoperative day the patient was allowed to sit out of bed. His diet had been gradually increased and he was ravenously hungry. Nineteen days after operation the patient was discharged from the hospital. At that time, he was having eight to ten bowel movements per day, most of which were partly formed. Following discharge from the hospital, the patient continued to gain in weight and strength and in two months resumed employment.

One year after operation, the patient appeared greatly improved. He reported that he was eating well, had had no indigestion nor pain, but did have four to six formed stools in twenty-four hours; his weight was 110 pounds.

The specimen removed consisted of the terminal 98 cm. of the ileum attached to 26 cm. of large bowel, including cecum, ascending colon, and part of the transverse colon. Approximately 70 cm. of the terminal ileum was bound together as a mass of adherent loops. Over the lower anterior surface of this mass, an appendix 9 cm. long was densely adherent. Fibrous adhesions also were present between the coils of ileum and the transverse and ascending colon and the cecum. The appendix was sharply kinked 1 cm. from its base. The opening of the appendix revealed a mucosal polyp covering a perforation which extended completely through the appendix into the adjacent indurated mass of mesentery and coils of ileum. After freeing the ileum from adhesions and extending it at full length, it was found that

the tip of the appendix was adherent to a point on the ileum 57 cm. from the cecum.

For a distance of 17 cm. from the ileocecal valve, the mucosa of the ileum was smooth, pale and granular, with complete obliteration of valvulae conniventes. The lumen of this portion was greatly narrowed, the bowel circumference being 3.5 cm. The wall was moderately thickened at the mesenteric attachment, measuring 0.7 cm., but only slightly thickened over other parts of the circumference. Proximal to this for 23 cm., the mucosal folds were visible, but were blunted and edematous. The bowel at this point measured 0.4 cm. in thickness and 4.5 cm. in circumference. An ulcerated gutter extended along the mesenteric attachment of this portion. Proximal to this for 29 cm. the wall was markedly indurated, measuring 1.1 cm. in thickness, with the circumference about the same. The mucosal plicae were obliterated and the lining showed a coarsely granular, dull white surface. At the proximal limit of this segment, the lumen became markedly constricted, and in this region there were two perforations which could be probed into the thickened mesentery. Proximal to this, there was a loop of ileum 16 cm. in length and greatly dilated, the circumference being 11.0 cm. The wall of this portion was densely scarred and measured 0.7 cm. in thickness. The mucosa was coarsely granular and showed no valvulae. Proximal to this for 11 cm., the ileum was constricted to a circumference of 4.5 cm. and the wall thickened to 1 cm. A gutter-like ulcer was present along the mesenteric attachment and irregular ulcers were scattered over the rest of the mucosa, but the mucosal folds remained indistinctly visible. The proximal 2 cm. of the specimen showed relatively normal ileum.

The attached mesentery was greatly hypertrophied and scarred; it was 2 cm. in thickness, and contained enlarged, hyperplastic lymph nodes. Scattered small abscesses filled with yellow purulent material were present in the dense fibrous tissue.

The mucosa of the appendix, except in the neighborhood of the perforation, appeared relatively normal, as did also that of the cecum and colon. The muscularis was not remarkable. The serosa of the large bowel was roughened by fatty fibrous tags.

Of the several sections of the ileum studied, some showed the muscle obscured by dense scar tissue (Fig. 9) and the mucosa almost completely absent. In its place was a layer of granulation tissue densely infiltrated with plasma cells, lymphocytes, neutrophiles and eosinophiles, with scattered foreign body giant cells present in places. Such granulation tissue extended deeply into the bowel wall at various points. (Fig. 10.) Occasionally, it was covered by a layer of regenerated simple columnar epithelium. (Fig. 11.) Other sections showed less of the muscle coat replaced by fibrosis and more intact mucosa.

The serosa and mesentery were densely scarred and hyperplastic, chronically inflamed lymph nodes were observed. Some sections revealed small foci of necrosis surrounded by dense lymphocytic and plasma cell infiltration with an outer zone of dense fibrosis. In the central part, endothelial cells and numerous foreign body giant cells were present. (Fig. 12.) The resemblance to tubercle formation was very superficial.

The appendix was not sectioned at the site of the perforation, but sections near this area showed intact mucosa with moderate scarring and leucocytic infiltration of the wall. The serosa was covered by fibrous tags.

The colon appeared relatively normal in the sections studied. The serosal surface was covered by congested, fatty, fibrous tags infiltrated with lymphocytes and plasma cells plus a few neutrophiles.

Cultures and smears made by the surgeon, and cultures, smears and animal inoculations of macerated tissue selected by the pathologist from ileum, lymph nodes and mesentery, revealed no significant organisms.

The pathologic diagnosis made was: chronic stenosing ulcerative terminal ileitis; perforations of appendix and ileum with fistulous tracts into iliac mesentery; chronic localized peritonitis; chronic hyperplastic lymphadenitis.

Two years after the primary operation, this patient was readmitted to hospital with an incomplete intestinal obstruction; there was some vomiting, moderate abdominal distention, but not complete obstipation. He was treated by continuous duodenal drainage, hot packs and intravenous fluids, but did not improve. Three days later, under spinal anesthesia, a jejunostomy was done but no attempt at exploration of the abdomen was made. This procedure afforded but temporary relief and the patient expired forty-eight hours after the jejunostomy.

At post-mortem, the peritoneal cavity contained about 200 c.c. of thin, cloudy reddish-

brown fluid which had penetrated to all portions of the sac. The serous surfaces of the bowel and the parietal peritoneum were dull

The large bowel, 74 cm. long, had a circumference of 4.5 cm. Its mucosa showed no ulcerations, but at the site of anastomosis of

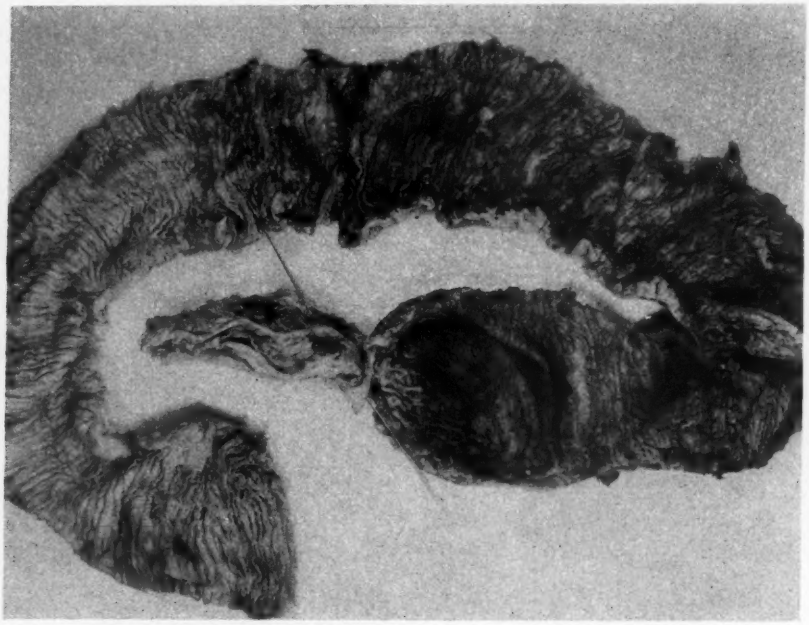

Fig. 13. Case 11. Portion of intestinal tract removed at post-mortem. The longer segment is small intestine and the short one is colon. Note the comparative size of ileum and colon, the ulcers of the mucosa of the ileum and probe passed through stenosed site of anastomosis.

and covered with a thin layer of fibrin. The distal portion of the terminal ileum was adherent to the right anterior aspect of the pelvic brim by fibrinous adhesions. Very slight traction on the bowel caused lacerations in the bowel wall at the sites of several large ulcers. The bases of the ulcers remained attached to the parietal peritoneum and a large amount of thin, dark brown intestinal fluid ran out through the perforation.

The combined length of the large and small bowel was 200 cm. The small intestine, 125 cm., was markedly dilated and filled with a thin, dark brown intestinal fluid. Its serosa had a bluish color. The upper third was 9 cm. in circumference, the middle third 10 cm., and the lower third 12 cm., while the bowel was 0.3 to 0.4 cm. thick. The distal third had many large ulcers varying in size from 0.3 to 3 cm. in diameter and tending to have their long axes perpendicular to the long axis of the bowel. The edges of the ulcers were clean and free of tubercles. The ulcers were so numerous that they covered about 30 per cent of the mucous surface in the lower third of the small intestine. The mesentery was slightly thickened and edematous and contained a few enlarged lymph nodes.

the ileum and colon there was a stenotic region 1 cm. wide with an internal diameter of 0.4 cm. (Fig. 12.)

The other abdominal viscera were not remarkable.

Microscopically, the mucosa of the ileum showed many ulcers which in some places extended down to the muscle layer, and even the remaining mucosa was edematous and infiltrated with polymorphonuclears and some monocytic cells in places, especially beneath the ulcers. The ganglion cells of the mesenteric plexus were granular and swollen. Many large collections of large and small monocytic cells were present between circular and longitudinal muscle layers. The serosa was thickened, edematous, infiltrated in some places with many polymorphonuclears and monocytic cells and was covered by a thin layer of fibrin.

Final diagnoses were: acute and chronic ulcerating enteritis; sero-fibrinous peritonitis; ileocolostomy (old) with stenosis at site of union; intestinal obstruction.

DISCUSSION

Clinically, these two cases agree in almost every respect with the disease entity, regional ileitis, as described by

Crohn and associates.[1] Case I ran a more acute course than most of those described, and Case II a much more chronic course, but wide variations in this respect are mentioned. Case II indicates the tendency to recurrence months after an apparently complete excision of the diseased intestine.

The pathology of these cases varied in certain definite ways from that first described by Crohn. Case I revealed typical involvement of the ileum and mesentery, but an acute ulcer of the cecum was present. The appendix in this case was probably "free from guilt" but its lumen was partially obliterated by fibrosis. The acute changes observed were peri-appendicitis, apparently secondary to the ileitis. Case II exhibited typical chronic ulcerating cicatrizing ileitis, or the "stenotic phase of regional ileitis," but the process irregularly involved the terminal 96 cm. of the ileum and an old perforation in the appendix might logically explain the entire pathogenesis.

Demonstration of a specific etiology for either of these cases was impossible. We believe they are further proof in support of the statement of Homans and Hass[13] who, after carefully studying two cases of this group, concluded: "We agree that a terminal ileitis presents a rather characteristic clinical picture, but acceptance of the local lesion as a pathologic entity is certainly premature, since criteria are lacking by which one can segregate this granulomatous process from similar lesions occurring elsewhere in the intestinal tract."

CONCLUSIONS

1. We believe regional ileitis to be a definite clinical but not a definite pathologic entity.

2. The terminal ileum, cecum and other parts of the small or large intestine may be involved in the process.

3. Diagnosis rests on the history, finding of a mass in the right lower quadrant, plus the typical string sign shown by *x*-ray.

4. Complete gastrointestinal series should be done in any suspected case, as the lesion does not always show up with a simple barium enema.

5. Treatment depends on the findings in each individual case and varies according to the acuteness or chronicity of the process. Resection eventually may be necessary in order to bring about a complete cure, but in the acute cases it is sometimes better to do a preliminary ileostomy, colostomy or anastomosis, with resection at a later date.

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INFILTRATIVE ANESTHESIA IN SURGERY OF THE GALL-BLADDER

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LOCAL infiltrative anesthesia has a definite place in abdominal surgery, particularly in cases where other types of anesthesia increase an already grave risk. It should not be used to the exclusion of general anesthetics, but if employed in judiciously selected cases, it will materially reduce the hazard of operation. It may be the method of choice in certain types of cardiac decompensation, in acute respiratory and some chronic respiratory disorders, in oral or pharyngeal infections and in some cases of chronic nephritis and hypertension. It should be used in the presence of a marked or dangerous degree of disturbance of acid-base equilibrium where time does not permit delay to correct the condition.

Not all patients are favorable subjects for the use of this method. The usual contraindications for its use are nervousness and fear on the part of the patient and lack of familiarity with technical procedure on the part of the surgeon. Ordinary apprehension is not of especial importance as some of the most coöperative patients are those who look forward to the procedure with considerable dread.

A consideration sometimes overlooked is the increased time required to complete the operation. This necessitates speed in operating sufficient to permit the work to be finished within the duration of anesthesia, which is ordinarily from forty-five to sixty minutes. Repeated use of the method leads to increased speed and proficiency so that reinforcement of the original infiltration is rarely required.

It must be impressed on the patient that local anesthesia differs from general anesthesia only in the consciousness of the patient and that no pain or suffering is to occur. If such a status cannot be maintained the method is of no value to patient or surgeon and should be modified or abandoned in any given case. The patient must also understand that pain is not to be confused with sensations of pressure, as the anesthetic will block all pain. The patient may, however, be conscious of tactile sensations when incisions are made or pressure is applied. It is extremely difficult to prevent discomfort when traction is applied to the attachment of any viscus and when such traction is unavoidable the underlying nerve supply must be thoroughly anesthetized.

The commonest causes of failure to obtain satisfactory painless relaxation are the indiscrete use of retractors, traction on visceral organs, pressure on the thorax or abdomen by the forearms of surgeon or assistant and failure to allow sufficient time after infiltration before beginning the operation. Essential to success are a sharp knife and sharp dissection of tissues rather than separation of layers by blunt or gauze dissection.

The nerve supply to the abdominal wall in the area from the costal edge to the level of the umbilicus arises from the seventh to tenth dorsal nerves. These nerves run obliquely to the long axis of the abdomen downward and inward from the level of the costal arch in a line roughly a continuation of the ribs. With their primary anterior and posterior divisions and cutaneous branches they constitute for practical purposes three separate sets of nerves to the abdominal wall: (1) sensory nerves to the skin; (2) motor and sensory nerves to the abdominal muscles; and (3) sensory nerves to the parietal peritoneum. The main trunks are quite uniformly parallel and equally spaced

in the upper abdomen, but because of the large amount of terminal overlapping on the same and opposite sides the use of morphine ⅙ gr. The use of such premedication assures a restful night and a tranquil state of mind at the time of operation and has the added merit of counteracting any toxic effect of novocaine. The combined use of barbiturates and large doses of epinephrine may precipitate untoward complications as may also the combined use of large doses of barbiturates and morphine, but no ill effects have been noted in the dosage suggested.

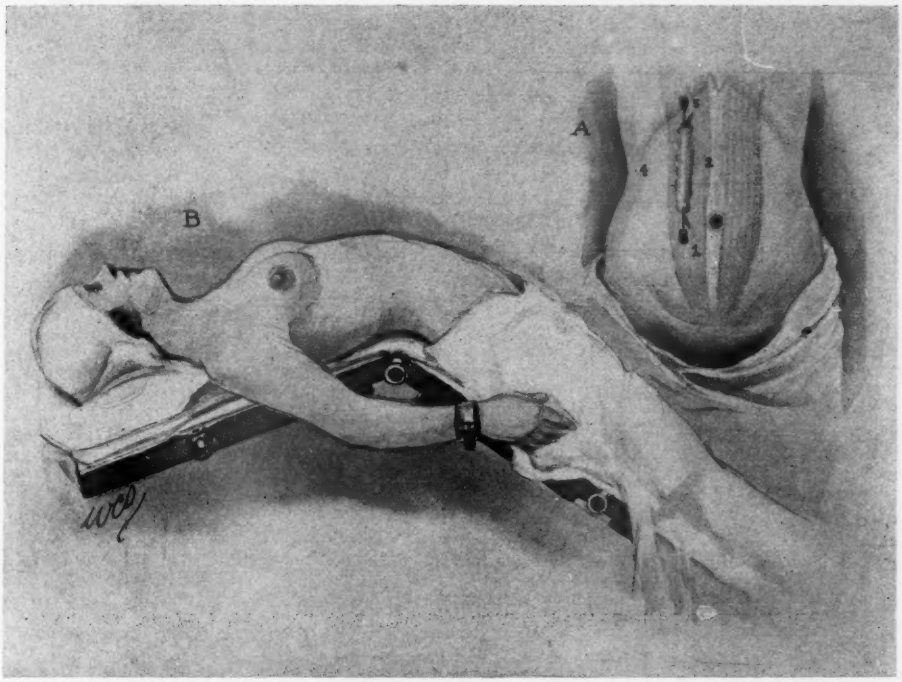

Fig. 1. A, superficial infiltration along the line of incision. Numbers 1, 2, 3, 4 mark outlines of area of infiltrative block. B, position of patient to obtain postural rotation of liver and gall-bladder. Note: The position of the right arm is obviously incorrect and is so drawn to permit a view of the dorsal elevation of the body.

purely conductive nerve blocking is not practicable and the local infiltrative block must be employed. So great is this overlapping of sensory fields that a single spinal root may be severed and hardly a trace of skin anesthesia result.

The nerve supply to the visceral area involved in cholecystectomy arises mainly from the eighth and ninth dorsal nerve roots, the nerves passing to their destination through the rami communicantes and the splanchnic and celiac sympathetic plexuses of the abdomen.

Premedication consists of the administration of 1½ gr. of pentobarbital sodium by mouth at 9 P.M. on the night before operation. A similar dose is given two hours before operation and is repeated one hour before operation, at which latter time ¼ gr. of morphine is given hypodermically. In women or in men of small stature the dose of pentobarbital sodium is 1 gr. and of

In the recumbent position the gall-bladder lies largely hidden by the parietal surface of the liver at the level of the ninth costal cartilage in the plane of the lateral margin of the right rectus muscle. Despite the numerous attachments of the liver by large vessels, ligaments and peritoneal folds a surprising degree of mobility can be attained by postural or traction rotation when the fixative action of the anterior abdominal wall is removed. Since traction is likely to produce pain and nausea, the method of postural adjustment is best employed.

In the position illustrated (Fig. 1), a 15 degree reverse Trendelenburg position with dorsal elevation, the liver slides against the diaphragm into a position of posterior rotation, elevating the anterior edge and exposing the entire length of the gall bladder without the use of traction. If the patient is placed in this position before being draped, rotation will usually be completed when the abdomen is opened and the gall-bladder will lie fully exposed immediately beneath the peritoneum. Occasionally it will be found necessary gently to assist rotation with the hand, but, once rotation is established, no instrumental retraction need be used to hold the liver in position.

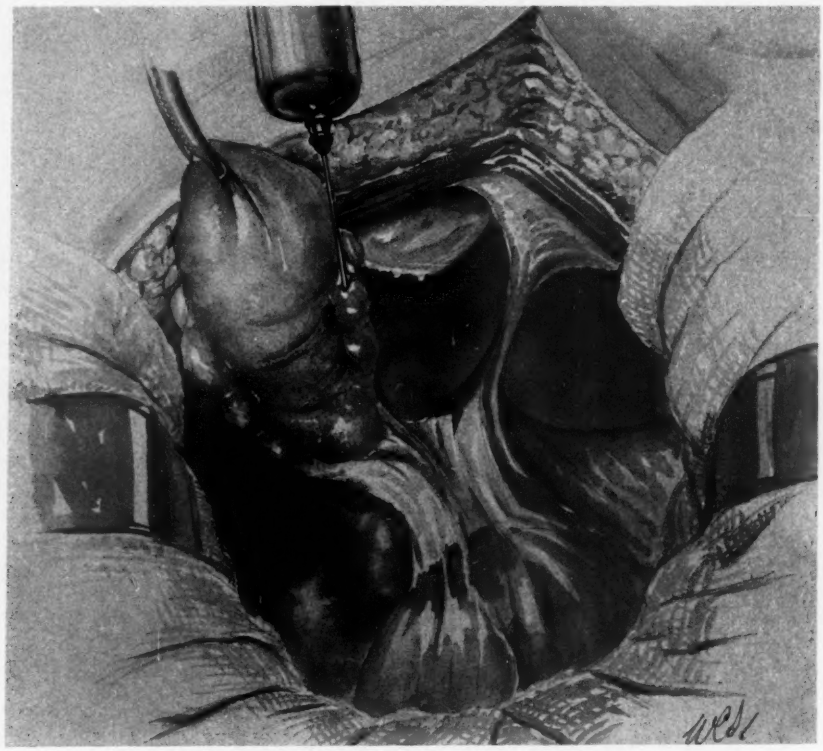

Fig. 2. Infiltration at attachment of gall-bladder to liver.

A ½ per cent solution of novocaine is used for all infiltration. Five drops of epinephrine solution 1:1000 is added to the first ounce only and this is used to infiltrate the line of incision. The injection apparatus has been reduced to the utmost simplicity and consists of a 5 c.c. luer syringe with a small gauge angulated needle and a 100 c.c. syringe to which is attached a small gauge rubber tubing 12 inches in length. At the distal end of the tubing is an angulated adapter which will receive a Luer needle 3 inches long. Angulation of the adapter greatly facilitates injection along planes parallel to the skin surface. The needle is directed by the surgeon and the syringe is handled by an assistant who maintains continuous pressure on the plunger.

A high right rectus incision of 4 or 5 inches will furnish adequate room for exposure without need of heavy traction and without the disconcerting expulsion of loops of intestine through the wound.

With the small syringe an intradermal wheal is raised at a point 1 inch below the lower end of the proposed incision. (Fig. 1A.) Changing immediately to the large syringe, the surgeon introduces the long needle through the same wheal and advances it subcutaneously along the entire line of incision and upward to the costal edge. With the needle vertical, the tip is plunged through the anterior sheath of the

rectus and the solution is injected subfascially along the same line. The level of subfascial injection is easily determined from failure thoroughly to flood the lateral costal angle. Distortion of structures may be avoided by dispersing the injected fluid

Fig. 3. Infiltration of gastrohepatic omentum. Transilluminator in place in the foramen of Winslow.

because of the characteristic sensation transmitted to the fingers when the needle pierces the fascia.

The area of deep abdominal wall infiltration is roughly triangular in shape, the base of the triangle being the upper linea alba, one side the right costal margin and the other side a line joining the two. An intradermal wheal is raised at a point 2 inches below the umbilicus just to the right of the median line and a line of subcutaneous infiltration is carried around the triangle and back to the starting point. The right costal margin is next infiltrated deeply into the muscular layer by a series of fan-like injections along the entire border. The same procedure is repeated along the medial side of the triangle, thoroughly flooding the sheath of the rectus muscle and continues across the abdomen to meet the lateral edge of the costal infiltration. Insufficient relaxation results most often with gentle massage. Ten minutes after infiltration the field is insensible.

Incision is made through the right rectus fascia and muscle exactly as with a general anesthetic. The transverse fibrous intersections of the rectus muscle may need a few extra drops of anesthetic at this time. The posterior sheath of the rectus and peritoneum are insensitive to pain from cutting and may be incised without infiltration provided that crushing and traction is avoided. The gall-bladder presents itself anteriorly and by gentle manual retraction the stomach can be displaced to the left and the colon displaced downward, each being kept out of the line of vision by a moist strip. The nerve block produces a surprising degree of muscular flaccidity and the wound edges may be separated with very light retraction.

If cholecystotomy alone is to be performed a few drops of novocaine injected

into the subserous coat of the gall-bladder are all that is needed, whereas cholecystectomy requires the addition of visceral block the deep sensory nerve supply by complementary splanchnic block. This is most simply done by lifting a portion of the

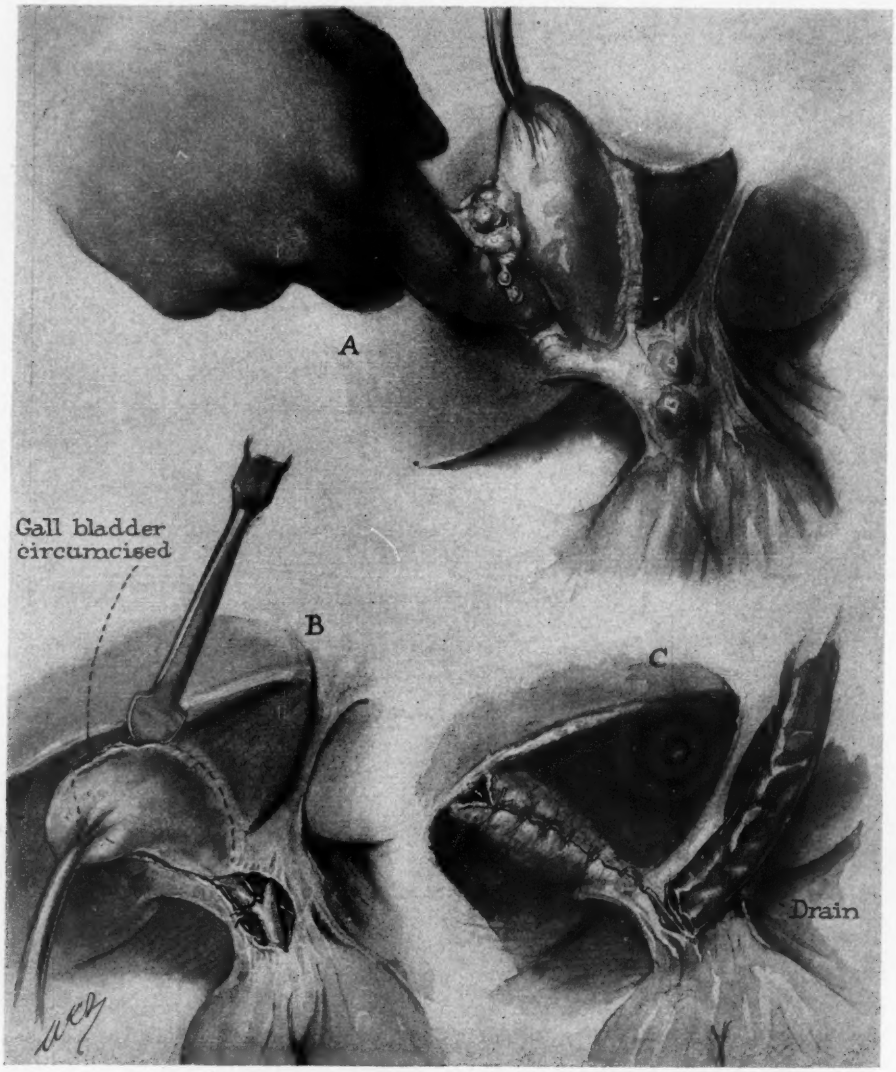

FIG. 4. A, dispersion of anesthetic solution by stroking. B, incision into the gastrohepatic omentum, dissection and ligation of cystic duct and artery. C, closure of denuded bed of gall-bladder. Penrose drain in position.

anesthesia. This is induced by the injection of novocaine solution into the fold of the gastrohepatic omentum and by a circumscribed subserous infiltration of the entire attachment of the gall-bladder to the liver. The latter step has the advantage of acting as an effective means of stripping the gall-bladder from its bed and greatly facilitates its bloodless removal. In cases with extensive adhesions where traction must be used on the gall-bladder it is necessary to uncut posterior parietal peritoneum in the infrahepatic fossa and injecting through a fine angulated needle 30 c.c. of novocaine solution behind the peritoneum. Care must be exercised to avoid injuring or injecting directly into the large vessels nearby. When injections have been made into the gastrohepatic ligament, subserous layer of the gall-bladder and beneath the posterior parietal peritoneum, the anesthetic may be spread beneath the serous surfaces by

stroking with the fingers, thus increasing the area of effectiveness and avoiding the distortion due to an excess of localized fluid.

Cholecystectomy is then performed according to routine procedure by splitting the anterior margin of the gastrohepatic omentum and isolating the cystic duct and cystic artery, which latter is ligated and divided. A pear-shaped incision is then carried upward close to the attachment of the gall-bladder to the liver. The gall-bladder is separated from its bed by dissection with a semi-sharp spatula knife, leaving it hanging by its sole remaining attachment, the cystic duct. This structure is divided between clamps and the common duct explored by palpation with the index finger through the foramen of Winslow and by distal probing through the open end of the duct. Proximal probing into the hepatic duct is to be undertaken only with a knowledge of the danger of producing intrahepatic impaction of stone or of injury to the duct with possible immediate or late obstruction.

Wound closure is effected in layers with provision for drainage through a small separate stab wound incision.

SUMMARY

Local infiltrative anesthesia has a definite place in surgery of the gall-bladder and adds a factor of safety in those cases in which the use of general anesthesia would be expected to increase the hazard of operative procedure.

Cholecystectomy may be performed painlessly and rapidly when postural assistance is utilized and blunt dissection and heavy traction are avoided.

Cholecystectomy usually requires the addition of infiltrative visceral and splanchnic block.

Simplicity of apparatus and of procedure make this a satisfactory method for use by the general surgeon.

IODINE METABOLISM AND THE HYPOTHYROID STATE*

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SINCE Gull reported five cases of hypothyroidism in 1875 before the Clinical Society of London there has been varied usage of the term. In his patients there was a marked apathy and he did not refer to myxedema as associated with the disease. Ord in 1877 reported six cases with edematous infiltration of the skin and since then the late stages of hypothyroidism have been referred to as myxedema or Gull's disease.

The suppressed or diminished thyroid state frequently does not produce the classical or cardinal symptoms on which a diagnosis can be made. The terminal stage of the disease or myxedema is rarely encountered, as compared to the symptoms produced by the earlier stages of hypothyroidism. Thyroid dysfunction, whether it is a hyperactivity or a hypoactivity, is due to imperfect iodine metabolism. We know from the work of Marine and Lenhart[12] that the iodine content of the gland is inversely proportionate to the epithelial hyperplasia. Therefore in an exophthalmic goiter the iodine is lowest and in a colloid goiter it is highest. The iodine content of the normal thyroid is given as 0.3 per cent of the dried weight of the gland. The gland contains either the inorganic iodine or thyroxin, the organic compound, or both. It is known that thyroxin is 65 per cent iodine.

In thyroid dysfunction it is necessary to consider iodine metabolism. We know that iodine is the one medication that will prevent adolescent and colloid goiter when sufficiently administered in the endemic goiter belts. Kimball[9] has recently given figures from the State of Michigan where the incidence of goiter in sections studied by him was 38.6 per cent in 65,537 children examined and after four years by adequate administration of iodine the incidence was 9.9 per cent in 50,134 children. In the nongoiter belts there is a definite percentage of thyroid disease that cannot be attributed to a diminution in the iodine content in the food or water. It is necessary to seek further for an explanation why these patients develop goiter. As the iodine ultimately unites with tyrosine, which is the end product of protein metabolism, to form the active principle of the gland, it may be that a disturbance in protein metabolism is an important factor in producing both hyper- and hypothyroidism. For that reason it would seem worthwhile to go into a more detailed discussion of the mechanism of the iodine and protein metabolism.

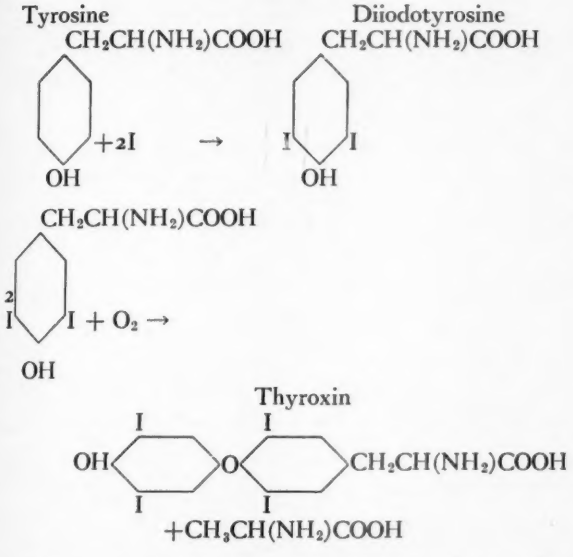
Since 1895, when Baumann discovered the presence of iodine in the thyroid gland, it has been known that iodine was in some way associated with thyroid activity. The site and the mode of action were not understood, until Marine and Lenhart[12] in 1909 proved that iodine, when administered to dogs, would produce rapid involution in the gland. In 1915, Kendall[8] isolated the active principle of the gland and called it thyroxin. Harington and Barger[5] in 1927 synthesized this substance from tyrosine. Sweet and Ellis[16] in 1915, while trying to determine whether dogs could live after ligation of the external ducts of the pancreas, noticed that the thyroids of these animals became quite translucent and that a type of colloid goiter was produced. The iodine content of these glands was increased. No explanation was given for this phenomenon.

It seemed to the author and his two co-workers[2] that the work of Sweet and Ellis was very significant in explaining the

* Read before the American Therapeutic Society, June 4, 1937.

metabolism of iodine. In the light of the work on the chemistry of thyroxin, it seemed possible that a lack of trypsin in the intestinal tract, under which condition the proteoses and peptones might not be hydrolyzed completely to amino acids, would explain hypothyroidism and possibly hyperthyroidism. From our experiments it seemed that the normal supply of tyrosine was not available in the thyroid for the formation of thyroxin. The relationship between thyroxin and tyrosine may be seen from their structural formulae:

FORMATION OF THYROXIN FROM TYROSINE

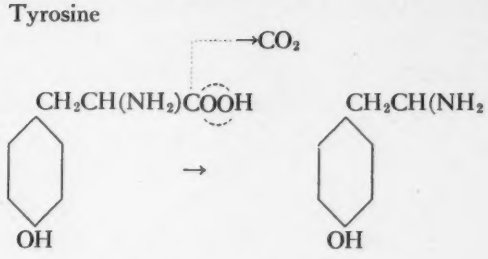


Also, it is to be expected that the iodine content of the gland would be increased after ligation of the pancreatic ducts because there would be less tyrosine present to mobilize it in the form of thyroxin, and hence the iodine would be deposited in the gland. This we proved by our experiments on dogs.

If a diminution in the tyrosine supply is a factor in the development of a colloid type of goiter, then perhaps, an excessive formation of tyrosine or an allied chemical substance, such as tyramine or phenylalanin, might result in the development of toxic goiters.

Tyramine is easily formed from tyrosine by carboxylation in the following manner:

FORMATION OF TYRAMINE FROM TYROSINE



In the body tyramine is known to be produced normally in small amounts by certain strains of colon bacilli. In a series of very thorough investigations, Hanke and Koessler[4] have shown that there are two separate strains of colon bacilli containing carboxylase—one forming histamine from histidine, the other forming tyramine from tyrosine. Both are active in this way only in an acid medium, probably as a protective mechanism. The latter strains form phenols from tyrosine in the more alkaline medium usually prevailing in the intestines. The physiologic effect of histamine is known to be antagonistic to that of tyramine; therefore, variations in the proportions normally formed might give rise to systemic disturbances. Various animal species seem to differ in the absorbability of these substances, but Coyle and Boyd[1] have shown that tyramine is quickly taken up from the large intestine of the dog, less quickly in the cat. The concentration of tyramine in the blood of humans supports the idea that it may be absorbed from the intestines, since that is the only known site of formation. It seems improbable that tyramine could be formed elsewhere in the body, except as a result of bacterial activity, since such a decarboxylating mechanism is not yet known and would involve an entirely new mode of catabolism for the amino acids.

For a number of years McCarrison[13] has claimed that thyroid disturbances are at least partly intestinal in origin. On administering tyramine to dogs, rats and pigeons, he noted the usual physiologic effects, similar to those of hyperthyroidism, but the gland was, if anything, diminished

in size and little changed histologically. He states that the ingestion of tyramine may cause exophthalmos, but that it is of rare occurrence.

Thyroid dysfunction may result either from a lack or an excess of the substances from which the active principle of the gland, thyroxin, is formed. These substances are tyrosine and iodine. An excess of tyrosine and a diminution of iodine might result in a form of thyroxin containing less iodine than normal, and a type of hyperthyroidism would be produced. If, on the other hand, not enough tyrosine was available to mobilize the iodine, a colloid type of goiter might result or there could be hypothyroidism without thyroid enlargement. Such disturbances could be brought about by intestinal disorders, dietary irregularities, scarcity of iodine in the diet, or dysfunction of the tissues normally responsible for oxidizing excess of tyrosine. Either an excess or an abnormal side product of the amino acids would be found in the latter case.

The histologic picture of normal thyroid should be considered before referring to the pathologic picture of the underactive gland. Kimball[9] gives 0.5 Gm. of thyroid per kilo of body weight as normal, i.e., a total of 20 to 35 Gm. of thyroid for a normal individual. After a study of human thyroids, it soon became apparent that the teaching of the normal histologic picture was based on insufficient data, and it was therefore obvious that conclusions as to the pathologic picture of the gland were likely to have different interpretations in the hands of different pathologists. The sections studied[6] were taken from humans meeting with accidental death and apparently in normal health at the time of the accident. All ages from stillbirths to those in the ninth decade were studied. This work has been reported in detail.

More recently I have had an opportunity to study normal dogs' thyroids while doing experimental studies[7] under Dr. Joshua Sweet in the Department of Experimental Surgery of Cornell Medical School. The histologic findings correspond to the human in that they represented a most bizarre histologic picture. I feel that one cannot determine the normal human thyroid by basing an opinion on the microscopic picture of the gland alone unless the studies are from serial sections of the entire gland. One would, accordingly, expect different opinions as to the normal physiologic state of a patient.

The thyroid secretion for a given individual must remain at a relatively constant level for normal health to be maintained. Kimball[9] recently stated that iodized salt is an efficient and safe method of preventing simple goiter, but stresses that the salt must have one part of potassium iodide to five thousand parts of salt. The incidence of goiter in Michigan was 38.6 per cent in 1924 before the salt was used. After a four year period of salt administration the incidence fell to 9.9 per cent in 1928.

The terminal stage of hypothyroidism or myxedema is well known and need not be elaborated upon, but the early stages of hypothyroidism produce most bizarre symptoms and for that reason the condition is frequently overlooked. It is known from the work of Sharpe and Bisgard[15] that complete removal of the thyroid in rabbits causes them to develop a macrocytic anemia. We know from the work of Emery,[3] Mackenzie,[11] and Lerman and Means[10] that anemia is also frequently found in patients with hypothyroidism. Schwanke[14] reports that 60 per cent of patients with exophthalmic goiter have a polycythemia, with the erythrocyte count between five and eight and one-half million. This makes one wonder if hypothyroidism may not frequently be the forerunner of both acute respiratory infections and secondary anemia. A very common complaint of a patient is that he has been "anemic" and under the care of a physician for same.

The clinical problem in hypothyroidism is provided by the vague symptoms so commonly attributed to some other organ or organs. To diagnose early hypothyroid-

ism is difficult, but one should suspect it when patients present the following complaints: dry skin with falling hair or baldness; apathy; general weakness; and nervousness, when fatigued, i.e., coming on late in the afternoon or early evening. Somnolence and constipation are common complaints. The laboratory aids are, of course, a basal metabolism reading and the cholesterol determination. It is at times necessary to treat a patient as a hypothyroid, although the metabolism may be reduced only to the lower limits of normal, if one is clinically certain of the diagnosis. At times most astounding results are encountered in these patients.

The lassitude is more marked on arising in the morning, improving during the middle of the day and returning in late afternoon or evening. Abdominal pain is frequently associated, with the period of lassitude, as are mental depression and irritability. The abdominal pain of the hypothyroid patient may be fairly typical of a peptic ulcer, but the periodicity is lacking. A long vacation with complete rest will frequently cause the symptoms to improve, but under the ordinary stress and strain of daily activity there is rarely any periodicity in the abdominal symptoms of the hypothyroid. Vomiting is occasionally encountered, usually when the patient is extremely tired.

A definite group of patients has peptic ulcer which cannot be demonstrated by roentgenologic examination. These patients give a typical ulcer symptomatology with periodicity perhaps extending over years with the intervals of freedom from pain becoming shorter and the severity of the pain gradually increasing. This type of patient obtains definite relief from a Sippy régime. The hypothyroid patient, however, rarely shows any improvement on an ulcer diet, in spite of ulcer symptoms. Obviously, not all patients suffering from ulcer symptomatology with negative *x*-ray findings have definite hypothyroidism. Yet some do, and if one is careful to evaluate the symptoms of hypothyroidism these cases can be diagnosed. A basal metabolism will usually verify the diagnosis.

The treatment should consist of thyroxin (1 mg.) intravenously once a week, with thyroid extract, gr. 1, orally twice or three times a day. It is important to continue the thyroxin administration intravenously at weekly intervals over a relatively long period of time, i.e., from eight to ten weeks. This may be governed by the clinical course of the patient. It is rare that any improvement is noticed in the symptomatology before four to six weeks have elapsed and it is therefore well to inform the patient that he will probably not have any benefit under a six weeks' period.

It would seem from the experiments on animals and the clinical results obtained from thyroxin administration that the therapeutic effects lies in the tyrosine radical of the molecule and not in the iodine content of thyroxin.

Treatment must be carried on for a long time, the metabolism should be checked at least twice a year, and the thyroid and thyroxin administration governed according to the clinical course and metabolic findings. After the patient is symptom-free and his metabolic determination normal, he must be made to realize that this state will not continue unless thyroid medication is taken at intervals over a period of months and perhaps years. Dietary regulations are not necessary and other medications, such as sedatives, are rarely administered. The improvement is due to a general stimulation of the metabolic processes. In patients who will not tolerate thyroid by mouth, thyroxin tablets, $\frac{1}{80}$ or $\frac{1}{60}$ gr. twice a day may prove very beneficial.

SUMMARY

The bizarre types of hypothyroidism apparently are due to the inability of the individual to metabolize iodine rather than to a true iodine deficiency. It would seem to be the organic radical of the thyroxin molecule that is at fault, as clinical

experience tends to support this view. For that reason much better results are obtained by the intravenous use of thyroxin, supplemented with thyroid extract by mouth. After the metabolism is elevated to normal, the thyroxin should be discontinued and the normal level maintained by oral administration of thyroid extract.

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LOW BACK PAIN AND SPINA BIFIDA OCCULTA

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THE subject of low back pain has, in recent years, received attention from and stimulated the interest of numerous investigators. An immense amount of literature has accumulated, demonstrating a large variety of theories and a conspicuous diversity of opinion with regard to the causes of the ailment, the mechanism of production of symptom complexes, and the forms of treatment. The foremost conceptions of this affliction are well known to students of the subject and require no review.

It should be mentioned briefly that, according to current theories, practically all the structures that comprise the region of the lower back have, at various times, been blamed as the source from which the pain arises. These include bones, joints, muscles, ligaments, fascia, nerves and, if necessary, the specialized tissues of the nucleus pulposus with its adjacent structures. The principal agents which have been accused or suspected as causes are trauma, inflammation, tumors, infection, posture and degeneration. The effects of these agents upon the supposedly vulnerable structures result in arthritis, osteitis, myofascitis, nerve compression and herniation. In some manner, not always easy to understand, the symptoms and physical signs appear in many forms and combinations to represent what is commonly called low back pain.

It is realized that the construction of the human body is such that any or all of the component parts of that region may enter into the production of pain; that pain may be extremely variable in location, intensity and extent, depending on the structures or tissues which are affected and the method by which the effect is produced. Added to this thought is the generally accepted notion that the lower back constitutes, in a mechanical sense, one of the most unstable mechanisms of the human body. This is customarily attributed to phylogenetic peculiarities and weaknesses in a part of the body which has in man not yet become sufficiently stable to meet the strains which are imposed on it.

It is at once obvious that no single theory, however well founded it may be, will suffice to explain all the situations which may be included within the range of the general term, low back pain. However, excluding the relatively small proportion of cases of this nature in which the symptoms are indisputably attributable to specific disease processes, there remains that vast majority of cases in which no accurate information is available on the etiology, pathology and pathogenesis. This constitutes the group of disabilities for which an explanation is sought in this analysis.

The object of this presentation is to establish a relationship between low back pain and spina bifida occulta. The material available for study consists of seven cases on whom operation was performed for relief of symptoms.

Spina bifida occulta is a congenital malformation of the spine, consisting of a faulty development of portions of the spine, usually the laminae. This malformation may assume several different forms. It may present itself as a cleft or incomplete fusion of the laminae; it may appear as a defect of the bone between adjacent laminae; it shows considerable variation in size and shape; it may be on one or both sides of the midline; it may be single or multiple. It is most commonly situated in the upper three sacral laminae. The term spina bifida occulta may be applied to any congenital

defect in the laminae of the upper sacral vertebrae. It is, contrary to general belief, relatively rare in the fifth lumbar vertebra.[1]

The importance of spina bifida occulta lies in its constant association with pathologic alterations within the spinal canal. These consist of masses of fibro-adipose tissue, overlying the dural sac and the nerve roots in the sacral canal. In addition, cords of fibrous tissue are found extending between the ventral surface of the laminae and the dura or the nerve roots. Both of these features are, by virtue of their construction and arrangement, capable of producing a mechanical irritation of the nerves sufficient to interfere with their function.[2]

SYMPTOMATOLOGY, TREATMENT AND RESULTS

For the purpose of this discussion, it is intended to adhere to the customary division of pain with radiation and that without radiation. In this series, all of the cases were of the former type.

From a study of the relatively few patients which form the basis of this analysis, it is evident that most or all of the subjective and objective manifestations can be attributed to changes in the muscles or tendons. The pains which form the patient's complaint can, in most instances, be reproduced by palpation of the muscles. Invariably the tenderness which is discovered by such examination is much more extensive than the history of the disability indicates. Thus it is possible to find areas of tenderness in many of the muscles or groups of muscles, not only in the regions where the patient is subjectively aware of them, but also in other sites where there was no suspicion of such findings. The favorite locations of tenderness are the upper portion of the sacrum in the midline and at either side of the midline, the gluteal muscles, the tensor fasciae latae, the iliotibial band, the gastrocnemius-soleus group, the peronei and extensors of the toes and the short plantar muscles of the foot. This form of tenderness is, as a rule, localized and limited to certain small areas of the muscle substance or the tendon, the rest of the muscle being quite normal in that respect. There is, in some cases, a very definite tenderness of the lumbar muscles, most prominent in the sacrospinalis. Further, the same findings may be noted in a less severe form, in the thoracic portion of the spine, the scapular muscles and some of the muscles of the upper extremity.

The findings in the muscles are usually bilateral, even though the symptoms are more prominent on one side or entirely confined to one side of the body. Tenderness is neither common nor severe in the hamstring muscles, the quadriceps femoris or the adductor muscles of the thigh. In those muscles in which tenderness is elicited, it is possible to detect muscle spasm, evident from the firmness of the muscle substance and the limitation of motion in the joints.

The tendon reflexes in the lower extremities are usually disturbed. The knee jerks and the ankle jerks are most often absent or diminished in their reaction, though they may be normal.

Limitation of motion is undoubtedly due to muscle spasm, which in turn is the result of reflex contraction of the muscle to avoid pain in stretching. This is illustrated in the restriction of straight leg raising movements, which is probably the result of spasm of the gluteus maximus.

There is reason to believe that the term "sciatica" is a misnomer. While undoubtedly, as will be shown, the pain in this disorder is primarily the result of nerve irritation, it is believed that the tenderness of the sciatic region in the thigh is, in reality a tenderness of muscle or tendon. In this connection, it is most probable that the pain so produced is in the hamstring muscles, the gluteus maximus or the portion of the fascia lata into which the gluteus maximus is inserted. Even more convincing that this is not a nerve tenderness is the observation that, in the presence of tenderness in the peronei, no tenderness can be found in the peroneal nerve.

It will be noticed that the clinical picture is very similar, in all its important aspects, to the form of muscular rheumatism which has been found in younger individuals where it affects more frequently the muscles of the legs and feet. The principal difference is the location of the chief symptoms.

Among the patients here studied, there were four males and three females, all of them presenting the picture of low back pain with radiation. The ages varied from 29 to 47 years. The duration of symptoms ranged from six months to fifteen years.

In all of them a combination of symptoms and signs, characteristic of muscular rheumatism, was found. This was evident from the presence of muscle tenderness, muscle spasm, limitation of motion, disturbance of reflexes, excessive fatigue on exertion and pain which was present more or less constantly. In five there was a history of constipation extending over a period of years and necessitating the use of cathartics.

The extent of their disability may be illustrated by the statement that five of the patients were bedridden for periods of three weeks or more previous to administration of treatment; the other two, though ambulant, were unable to perform their customary work.

The roentgenologic changes seen in the sacrum were very uniform and consisted of defects in the laminae of the upper sacral vertebrae. There was no evidence of a spinal cleft, such as is more commonly seen in children and adolescents. The laminae were united in the midline and small defects were visible on either or both sides of the midline. (Figs. 1 and 4.)

The pathologic changes in the spinal canal were typical in all cases but one. In this the nerves distal to the dural sac were matted together by firm fibrous tissue. A few small particles of fat tissue were found overlying the nerve roots, but for the most part, it seemed that any nerve disturbances which might originate from these changes were the result of conditions which at the time were considered irreparable. Added to this fibrosis was the presence among the fibrous tissue of several veins, somewhat dilated and tortuous, thin-walled and friable. In all the other cases the characteristic alterations were found.

Spinal fluid obtained at operation in five cases was clear, showed cell counts of 15, 49, 95, 200 and 730 per c.mm.

The operative procedure consists of a laminectomy of the upper three sacral segments and removal of the pathologic structures within the canal. Of the seven patients so treated, three, all males, are entirely free from their former symptoms. They have been under observation for fifteen to seventeen months since operation. Two have returned to their work as laborers; the third spent three months after operation in recovering from his disability, but is since that time completely relieved and able to participate in activities, such as playing baseball and hunting. Three other patients, all females, are improved in the sense that their muscular pain and tenderness have been eliminated. The period of observation since operation ranges from seven months to eleven months. They are better able to carry on their activities, though they are still somewhat disabled by conditions which are clearly in no direct relation to the sacral nerves. In one case in which the findings at operation were atypical and apparently beyond repair, there was no change.

CASE REPORTS

Case 1. G. J., age 36, white, male, was seen on April 16, 1936, complaining of pain in his back and right hip. Symptoms began in December 1935, when he first noticed a "catch" in his right hip in stooping over. While at work as a laborer, he developed a severe pain in the right gluteal region. This radiated sharply to the outer aspect of the leg, and was produced by bending forward. Pain subsided when at rest. He had no relief from medicines or counterirritants, could not perform steady work or heavy work, and at one time he was confined to bed for three weeks, on account of pain. His hands become numb very easily

when he drove a car or used a shovel, so that about every five minutes he had to rub them or activate them in order to restore normal sensation.

Examination revealed a list to the left and a mild atrophy of the right gluteal region. Forward flexion of the spine was definitely restricted and produced a sharp pain in the lower portion of the right gluteus maximus. If carried further, the pain radiated to the leg and foot. Bending backward and to the left were free. Pressure tenderness was noted in the lumbosacral region and in the lower part of the gluteus maximus.

X-ray showed a small defect on the right in the first sacral lamina; another on the left in the upper portion of the second sacral lamina. Both were oval in shape, smooth in contour and dimly outlined against the background of the bodies of the sacrum. (The findings as shown in the print are too dim for accurate reproduction. In general they are similar to those in Figs. 1 and 4.)

The patient was seen again in August 1936. He had during the interval been engaged in various types of manual labor. He had pain in the lower back and right leg more or less constantly, whether he was working or resting. Ten days previously he had been drenched in a rain and this aggravated his condition so that he could not sleep at night. For the three days and nights he had not slept more than ten minutes at a time, and this was accomplished after administering ½ gr. of morphine. The right leg was painful and numb, and the right ankle was hot and swollen. On measurement his right ankle showed a circumference one-half inch less than his left.

It was also ascertained that he had headaches frequently. These were associated with an obstinate constipation extending over a period of many years.

Examination revealed definite tenderness of the sacrum at various points and on both sides of the midline at that level. In the right gluteal region there was very severe tenderness in the middle portion of the gluteus maximus. Further tenderness was elicited at different points in the upper third of that muscle. In addition, tenderness was found in the tensor fasciae latae, the iliotibial band, the gastrocnemius and peronei in the leg and the short flexors and extensors of the foot. The findings on the left were very similar in distribution though not so marked. There was no tenderness of the peroneal nerve on either side.

Dorsiflexion of the foot was painful. Straight leg raising was restricted at 30 degrees on the right and at 40 degrees on the left. The right knee jerk was absent, the left was slightly active but irregular. The ankle jerks were absent and there was no ankle clonus or Babinski sign.

Operation on August 22, 1936, consisted of removal of the laminae of the first, second and part of the third sacral segments. No defects were noted in the bony structures. From the ventral surface of the second sacral lamina, two heavy cords of fibrous tissue were seen proceeding cranially to be attached to the dura laterally at the level of the first sacral segment. These cords were irregularly flat on cross section. Several small particles of fat tissue were removed from the nerves lateral and distal to the dural sac. The spinal fluid was clear and contained 49 cells per c.mm.

Dr. C. A. Hellwig reported the pathologic findings as follows: "The specimen consists of three small masses of hemorrhagic fat tissue. Microscopically, the masses of fat tissue are divided into lobules by fibrous tissue septa. In several areas, fibrosis is noticed. No inflammatory cells are found. There are a few brownish iron pigment granules and many red blood cells in the fat tissue."

For about seventy-two hours after operation the patient had severe pain in his back and right leg. Beginning with the fourth day, he had much less pain, was able to sleep and to assume positions in bed which previously were impossible due to pain. Four weeks after operation he was entirely free from pain. The numbness of the leg and foot had disappeared. He had free movement of the back and both lower extremities. He had been doing work about the home and stated that he could do light work continuously for three hours without any of his former symptoms.

He volunteered the information that his hands no longer become numb when he is using implements. His feet felt warm and more comfortable. He had regular bowel movements without the use of laxatives. On examination, he showed a mild tenderness of the right gluteus maximus. Straight leg raising was possible to 60 degrees on the right and to 75 degrees on the

left. Knee jerks were regularly obtainable though not normally strong.

He has been seen at intervals for fifteen months after operation, and has never had any recurrence of his former symptoms, even though he has engaged in hard manual labor. He stated that he had worked for a number of days in the harvest fields, on some days spending twelve hours at this type of work, without more than the ordinary amount of fatigue or discomfort.

Fig. 1. Case II. Roentgenogram of lumbosacral region showing defect of bone in the second sacral lamina on both sides of the midline. Immediately below the spinous process of the first sacral segment, at the right of the midline is a round area several millimeters in diameter, in which the defect is complete throughout the entire thickness of the lamina.

Case II. Mrs. F. L., age 26, white, was seen in December 1936, complaining of pain in the lower part of her back and the right hip and leg. About eleven years previous she was thrown from a horse, and although she was not injured, several months later she noticed a sharp pain in her back when twisting her body. Some years later she noticed that the pain radiated to the right hip, but was not severe or constant. Two months before she was examined the pain appeared in the right buttock and radiated to the lateral aspect of the leg. Since then it had become gradually more pronounced, and for the three weeks it had been present continuously, regardless of activity or position of body. During that time she had been confined to bed.

Fig. 2. Case II. Photograph showing ventral surface of laminae, with several fibrous cords attached. Nearby are shown specimens of fat tissue removed from sacral canal. The length of the bone specimen was 6 cm.

She had had headaches all her life, sometimes for three days a week. These were at times associated with numbness of the fingers, hand and arm on the right side, and occasionally with partial blindness of the right eye. She used laxatives constantly until several years before. Previous to the birth of her child, sixteen months previous, she had always had severe cramping pain for two or three days preceding menses. Since that time, menstrual pain had been slightly less severe.

The patient walked slowly with a limp on the right. Her feet were abnormally cold though not discolored. The right hip was maintained in a position of slight flexion. In the region of the anterior superior iliac spine on both sides the skin showed atrophic striae. Straight leg raising was restricted on the right at 35 degrees and on the left at 45 degrees. Tenderness was elicited in the upper part of the sacrum and on both sides of the midline at that level; on the right in the gluteus maximus, the tensor fasciae latae, the gastrocnemius, the short flexors of the toes and the short extensor of the toes; on the left only in the gastrocnemius. It was most prominent in the lower portion of the right gluteus maximus, where it was possible to reproduce the pain which the patient experienced subjectively.

Knee jerks and ankle jerks were exaggerated on both sides and there was a mild ankle clonus on each side.

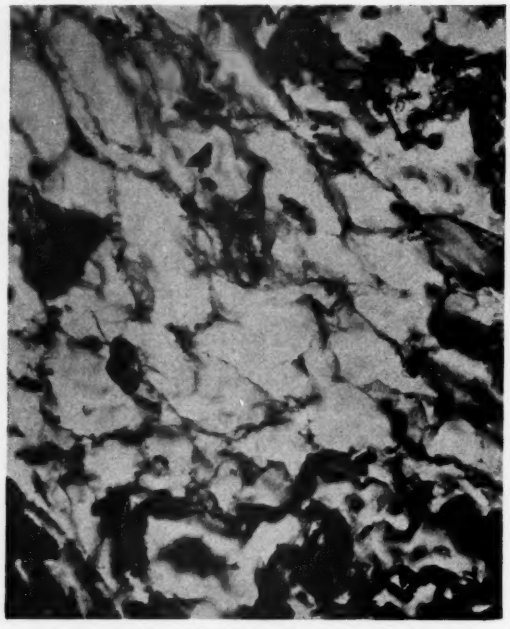

Fig. 3. Case 11. Photomicrograph of fat tissue, showing fibrosis. In addition there was evidence of round cell infiltration and old hemorrhage.

Roentgenographic examination showed a bony defect in the upper portion of the second sacral lamina on both sides of the midline. (Fig. 1.)

At operation, December 4, 1936, the laminae of the first and second sacral vertebrae were removed. On the ventral surface of the laminae, a number of bands of fibrous tissue were found, extending to the contents of the canal. (Fig. 2.) In addition a layer of fat tissue was seen to cover the lower end of the dural sac and the nerve roots. This was removed in small fragments. (Fig. 2.) Spinal fluid, obtained at operation, was clear and contained 95 cells per c.mm.

Dr. C. A. Hellwig reported on the tissue: "In the specimens of fat tissue, there are areas of dense fibrous tissue. There are a few leucocytes and areas showing deposits of old blood pigment." (Fig. 3.)

Recovery from operation was favorable. After four or five days the pain was decidedly less intense. The patient continued to improve and was discharged from the hospital on the twelfth postoperative day. Since then she has been free from the pain for which she was treated. She resumed her activities at home. During four months following operation she gained 19 pounds in weight. There was a noticeable decrease in the intensity of menstrual pain. There was a mild tenderness of the

Fig. 4. Roentgenogram of lower spine in female patient, age 36 years. Had pain in back for fifteen years. Shows bony defect in lower part of first sacral lamina, and encroaching on spinous process at left of midline. A similar, though less conspicuous, defect is seen in the lamina of the second sacral segment, immediately to the left of the midline.

gastrocnemius on the right though she has no subjective pain. While she is much more able to perform her household tasks, she still has mild discomfort and a tired feeling in the muscles of her back, which affects the muscles of the lumbar region of the spine. There was no change in the intensity of headaches, in the frequency of attacks of numbness in her fingers and hand, or in the tendon reflexes. Straight leg raising is possible to 80 degrees. These findings represent her condition, ten months after operation.

DISCUSSION

From the analysis of the cases the most important feature is the demonstration of the pathologic changes in the spine. These can very certainly be considered as essential factors, or probably the actual cause in some cases of low back pain. This conclusion is justifiable in those instances in which complete relief is obtained by eradicating them. In the cases in which symp-

tomatic relief is not complete, it is noted that whatever disability is not influenced, is clearly not attributable to any disturbance of function of the sacral nerves. The most gratifying aspect of this form of treatment is the regularity of disappearance of the most serious symptom—pain. Coincident with such relief is a greater freedom of muscle action and in some instances a subsidence of certain visceral disorders, the most prominent of which is a spastic constipation.

In some patients there is a certain amount of residual disability, consisting of a weakness, with or without a moderate degree of pain in the paraspinal muscles of the upper lumbar region. This condition may or may not be of importance to the patient or the physician, previous to treatment. After treatment, however, when the most conspicuous symptoms have been corrected, such handicaps become more prominent. From a study of such patients, it is most probable that the clinical features which remain are caused by a similar form of pathologic change in the spine, and situated at a higher level in the spinal canal.

SUMMARY

A study is made of seven cases of low back pain with radiation. Most of these, at the time of treatment, were bedridden and all were handicapped in their activities. Low back pain with radiation is, in some instances, manifested by clinical findings which are confined to the muscles. These consist of tenderness on pressure, pain on stretching and muscle spasm with the resulting limitation of motion in the joints. This symptom complex, characteristic of muscular rheumatism (Port) was noted in all of the patients in this series.

Associated with the muscular symptomatology are congenital defects of the sacrum which are identified as spina bifida occulta. Bony anomalies of this type are invariably accompanied by pathologic alterations within the spinal canal. These consist of masses of fat and fibrous tissue, in close contact with the nerve roots in the canal, and so arranged that a mechanical irritation of the nerves is produced.

Treatment consists of surgical removal of the offending tissues from the canal. By this procedure a prompt cure or improvement may be obtained in a high percentage of cases.

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CASE REPORTS

PRIMARY CARCINOMA OF THE GALL-BLADDER*

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IN reviewing the literature on carcinoma of the gall-bladder it becomes apparent that this subject has received relatively little attention. The first twenty volumes of Index Medicus (from 1927 to 1936 inclusive) list less than 100 references to this subject in all its phases. In this communication we propose to show that this disease is not as uncommon as is supposed and that it is amenable to surgery.

The cases reviewed in this paper were taken from the records at the Jewish Hospital for admissions between 1932 and 1936 inclusive. During this period there were thirty-one cases of carcinoma of the gall-bladder admitted to the hospital of which number twenty-seven were subjected to surgical intervention. The incidence of this disorder in all admissions to the hospital was 0.04 per cent and in surgical gall-bladder cases 2.5 per cent. (Table 1.) This disease constitutes 0.6 per cent of the autopsy material and 4.4 per cent of the carcinomata seen at necropsy.

Illingworth[1] at the Edinburgh Royal Infirmary noted thirty-six cases of primary carcinoma of the gall-bladder in 8,490 autopsies. During this period there were 1,275 cases of malignant disease at autopsy. Carcinoma of the gall-bladder therefore accounted for 0.42 per cent of all autopsies and 2.8 per cent of all malignancies seen at necropsy. This same author quotes Wilkie as having a 2.2 per cent incidence of carcinoma of the gall-bladder in 1,057 operations on the biliary tract. Graham[2] reviewed the work of von Berencsy and von Wolff who reported 19,908 necropsies. In this series there were 2,214 carcinomata of which number 300 (1.5 per cent) were carcinoma of the gall-bladder. Kaufman[3] states that "according to observations in Breslau it occurred in 5 per cent, according to those at Basel 5.19 per cent and according to Gottingen over 7 per cent of carcinoma cases autopsied." Smithies[4] in 1,000 consecutive cases of gall-bladder disease found that twenty-three (2.3 per cent) of the cases had primary malignant disease of

TABLE 1

	1936	1935	1934	1933	1932	Total
Number of cases admitted	15,269	14,616	14,988	14,909	14,261	74,043
Number of all carcinoma cases admitted	394	401	337	357	345	1,834
Number of all autopsies excluding new born	171	226	255	228	194	1,074
Number of all carcinoma cases at autopsy	29	42	37	31	19	158
Number of surgical acute and/or chronic cholecystitis cases with or without calculi	247	200	190	208	233	1,078
Number of surgical cases of carcinoma of gall-bladder	5*	6*	8*	3	5	27
Number of autopsies for carcinoma of gall-bladder	2*	1*	2*	2	0	7

* One surgical case came to autopsy in 1934, 1935 and 1936.

* From the Department of Surgery, Jewish Hospital.

the gall-bladder. Judd and Gray[5] in 22,365 operations on the gall-bladder and biliary ducts found 212 primary carcinomata of the gall-bladder—a surgical incidence of less than 1 per cent.

Like carcinoma elsewhere in the human this is distinctly a disease of cancer age. In the cases presented in this paper the youngest patient was 51 years of age and the oldest was 77 years. Over 60 per cent of the cases occurred between 54 and 63 years of age. Fifty-six per cent of the female cases occurred before 60 years of age whereas only 16 per cent of the cases occurred in the male before that age. Illingworth reports that the greater majority of his cases occurred between 50 and 65 years of age.

Cancer of the gall-bladder, like the inflammatory disease of the gall-bladder, is more common in the female than it is in the male. In our cases it occurred twenty-five times in the female and six times in the male—a ratio of 4 to 1. Illingworth reports a sex incidence similar to ours. Judd and Gray report an incidence of 3 to 1, Ewing believes that the ratio is 4 or 5 to 1. Rolleston and McNee,[6] reviewing the Registrar General's returns in England and Wales from 1913 to 1920, found 2,296 cases of carcinoma of the gall-bladder in females and 946 in males—a ratio of approximately 2.5 to 1.

ETIOLOGY

Various etiologic causes have been ascribed to carcinoma of the gall-bladder, the most common one being foreign bodies (calculi) within the gall-bladder. Experimentally, Kazama[7] and later Leitch[8] were able to produce carcinoma by the introduction of various foreign bodies into the gall-bladder. They employed pebbles, suture material, mucous membrane from the gall-bladder, lanolin and gallstones. Clemente[9] did the same with tar. Delbet and Godard[10] used calculi taken from patients with the disease. All they could observe were hyperplastic changes in the wall of the gall-bladder but no neoplastic changes. Burrows[11] repeated the latter experimental work, using stones from noncancerous patients. He too was unable to produce malignancy of the gall-bladder. He did observe proliferative changes in the elements of the gall-bladder which macroscopically appeared malignant but microscopically presented none of the characteristics of malignant disease. His experimental work suggests caution in accepting the result of his predecessors and the theory that gallstones are the causal agents of carcinoma of the gall-bladder. Shelley[12] reports a case in which a piece of tape was left in the gall-bladder for eighteen years. The gall-bladder was subsequently removed and examined microscopically. No evidence of malignant change could be found.

Clinically it has been repeatedly observed that carcinomatous gall-bladders frequently contain calculi. In our own cases nineteen contained stones, six did not and in six cases there was no mention whether stones were present or not. Thus, 76 per cent of the known cases contained calculi. Judd and Gray report calculi present in 64.6 per cent of the gall-bladders with malignant disease, Musser[13] in 69 per cent of the cases and Courvoisier[14] noted it in 91 per cent of his cases. The presence of stones even in so high a percentage of the cases does not necessarily make that the causal agent. May it not be that the self-same agent which causes carcinoma of the gall-bladder leads to the formation of calculi and that, gall-bladder calculi and carcinoma of the gall-bladder are due to concomitant changes in the mucosa?

PATHOLOGY

Macroscopic. The gall-bladder may be enlarged and present a nodular appearance—single or multiple. Or, it may be diffusely infiltrated and feel hard. In other instances it may appear normal to all intents and purposes except for a small local area of induration. When cut across, the wall is thickened and the lumen may be encroached upon by the nodular growth or by a papillary neoplasm. In the papillary form

there may be present a degenerating villous growth occupying the greater part of the lumen of the gall-bladder. Not infrequently the neoplasm extends outwards and into the wall of the gall-bladder as an intramural local mass. Within the gall-bladder there generally are some calculi and bile-stained mucopurulent material or colloid material. In other instances the gall-bladder is shrunken and all that remains of the organ is a diffusely infiltrated wall with a slitlike lumen in which there are biliary calculi. The two most common sites of malignant changes are (1) in the region of the fundus and (2) at the opening of the cystic duct.

Microscopic. Illingworth suggests four principal types: (1) schirrhous; (2) papillary; (3) mucoid or colloid; and (4) squamous. The reader is referred to his article for some excellent photographs and photomicrographs of carcinoma of the gall-bladder.

I. *The schirrhous carcinoma* is an infiltrative adenocarcinoma, containing irregular groups of nests and strands of columnar or cuboidal cells imbedded in a fibrous tissue stroma. In our cases sixteen, or over 50 per cent, were of this type.

II. *The papillary*, too, is an adenocarcinomatous type. However, it tends to grow in villous form, pedunculated or sessile, and is composed chiefly of columnar cells. In our series four were of this type.

III. *The mucoid or colloid* is composed of structureless areas of colloid material infiltrating the walls of the gall-bladder. The tumor cells are ill defined, flattened, and contain mucoid material. In the present study two cases were of the colloid type.

IV. *The squamous cell carcinoma* tends to form squamous-like epithelial cells which may show epithelial pearl formation and keratinization. Two such cases were observed in this series.

In two of our cases the cytologic composition was variegated. The cell structure tended to resemble an adenocarcinoma. The pleomorphic characteristics of the cells however, did not permit grouping these cases in any one of the above subdivisions. In the remaining five cases no biopsy was taken because of the extensive metastasis to the liver and poor condition of the patient at the time of operation.

CLINICAL ASPECTS

There are no symptoms or signs pathognomonic of this disease. Since it is always associated with a chronic cholecystic condition, the symptoms will vary with the severity of the onset of the latter disease and its duration, the situation of the neoplasm and its size and the associated secondary changes. In more than half of our cases (sixteen) the history suggested gall-bladder dysfunction for more than two years and in six cases for more than ten years. (In three cases there was a history of chronic biliary disease of over twenty years.) In the latter six cases acute exacerbations began to occur from one month to one year before admission to the hospital. In the remaining fifteen cases in which no past history of acute biliary disease could be elicited, five gave a history of less than three weeks of illness, one of only four days.

Abdominal pain was the one outstanding symptom complained of by almost every patient. The pain varied from a more or less constant dull ache in the epigastric region to a severe generalized abdominal cramp followed by a persistant ache in the upper abdomen. Pain was present in twenty-six of our cases and in nineteen it was confined to the right upper quadrant of the abdomen. Associated with the abdominal pain, ten patients complained of pain in the right costovertebral region or in the right shoulder. Belching, pyrosis and distress after meals were present in twenty patients and loss of weight and loss of appetite in sixteen. Nausea and vomiting, contrary to what others have observed, were present in only fifteen (less than 50 per cent) of our patients. Jaundice, itching skin and acholic stools were observed in only eight patients; and constipation in

six. Other symptoms which were encountered in different patients were dyspnea, insomnia, chills and an intra-abdominal mass.

On physical examination of the abdomen a palpable liver with various degrees of enlargement and changes in contour of its edge was found in twenty-two cases. A mass in the region of the gall-bladder which was taken to be that organ was present in nineteen cases. In another nine, there was an indefinite mass in the right upper quadrant which was suspected of being and was later shown to be gall-bladder.

Roentgen studies have not been of help in diagnosis. In fact, such studies were often misleading in that they revealed calculi within the gall-bladder and were the basis of the erroneous diagnosis of chronic cholecystitis and cholelithiasis, and the cause of delay in institution of surgery.

The diagnosis of carcinoma of the gall-bladder should be considered as more than a remote possibility in any patient of cancer age who gives a history of gall-bladder disease, who begins to have constant annoying aches in the right upper abdomen with some loss of weight, and in whom a mass is found in the right upper quadrant. It is, however, important to institute surgical therapy in the suspected case and so modify the procedure if carcinoma is found at the time of intervention that a radical excision is performed. Cholecystectomy may not always be adequate. The surgeon should unhesitatingly remove the involved contiguous liver tissue if he is to treat carcinoma of the gall-bladder. This procedure was performed in three of the reported cases.

The foregoing more or less completely describes the findings in all cases of carcinoma of the gall-bladder. It would serve no purpose to present many illustrative cases; suffice it to present one exemplary case in detail.

N. P., a white female, aged 57 years, was admitted to the Jewish Hospital on October 6, 1937. She was always in good health until six months before admission when, without apparent cause, she suddenly developed severe epigastric pain followed by nausea and vomiting. Several days after recovery cholecystography was performed and revealed calculi in the gall-bladder. The patient was put on a fat-free diet but did not improve. There were several episodes of recurrent epigastric pain which were accompanied by pain in the right infracostal and subscapular regions; these latter pains, however, were variable in severity. There was a loss of about twenty pounds in two months. At no time was there any jaundice or clay-colored stool.

Examination revealed an obese white female, not acutely ill. The head, eyes, ears, mouth, throat, glands, heart and lungs, genitourinary and nervous systems were essentially negative. The abdomen was not distended, soft, obese and tender in the right upper quadrant just below the costal margin. There was a tender mass about 2 inches below the right costal margin which appeared continuous with the liver. The liver edge was just palpable. The blood chemistry, Wassermann and icteric index were within normal limits. The hemoglobin was 74 per cent, the white blood count was 12,600 with 92 per cent polymorphonuclear cells and 8 per cent lymphocytes.

Two months prior to admission a Roentgen examination had been made of the gall-bladder region, fifteen hours after the ingestion of a suitable amount of gall-bladder dye; another film had been made twenty-four hours later and fifteen hours after taking the second dose of gall-bladder dye. This was followed by fluoroscopy in the upright and prone position during and following the ingestion of a barium meal.

On the first group of gall-bladder films: The kidney outline was sharp and clear. The liver edge was not clearly visualized. Very faint shadows suggestive of calculi were seen near the twelfth rib and close to the lumbar spine. There was no evidence of a gall-bladder shadow.

On the film made after the second dose of dye: There was still no evidence of a filled gall-bladder shadow. The calculi visible in the region of the gall-bladder were very plainly seen and formed a group of eight ring-like shadows with very thin borders. There was still no evidence of dye within the gall-bladder.

On upright fluoroscopy: The barium mixture passed rapidly and smoothly through an esoph-

agus which was normal in shape, position and motor activity. The mixture passed readily through the cardiac orifice and fell rapidly

FIG. 1. Resected tissue showing the anterior liver surface, the cut surface of the liver, the sectioned round and falciform ligaments and the neoplasm embedded in the liver substance.

along the lesser curvature to the lower pole. The stomach was J-shaped, with its greater curvature about 4 inches below the level of the iliac crest. The stomach was flexible, freely movable and not tender. There was no evidence of gross deformity in contour, nor was there any evidence of local spasticity. Very little peristalsis was established. The region of the pyloric ring was not adequately visualized and the cap was not even indicated in position.

On prone fluoroscopy: The contours of the stomach were sharp and clear. There was still no evidence of deformity. The pyloric ring was adequately visualized and, when seen well the canal was normal in width and length; filling of the duodenal cap was inadequate. At rare intervals, a small amount of barium was seen in the cap, but the outlines were never sharp or clear. The size was always much less than normal and even when best filled, it appeared flattened with faint and irregular contour. There was no suggestion of consistent deformity characteristic of ulcer.

On October 7, 1937 the patient was subjected to surgical intervention. A right upper midrectus incision was made. The gall-bladder was distended, and there were many adhesions between the gall-bladder, the duodenum, the transverse colon and the omentum. There was a nodule the size of a small egg at the fundus of the gall-bladder and another the size of a walnut just to the right of the round ligament and within the substance of the liver. The gall-bladder contained many calculi. No other masses or infiltration could be seen or felt within the liver. The liver itself was dull and cirrhotic. The stomach and duodenum were normal and the transverse colon and hepatic flexure were normal. The common duct did not contain any palpable calculi. The pancreas was normal.

Procedure. The adhesions to the gall-bladder were separated. The cystic duct was isolated and tied, the cystic artery was similarly treated. The right hepatic and common hepatic ducts which were adherent to the nodule in the gall-bladder were dissected free from it up to the portal fissure, and the gall-bladder was dissected up further for a short distance. A pyramidal area of liver about 4 by 5 inches, with its apex at the portal fissure and including the gall-bladder with the neoplasm and metastatic deposit together with the round and falciform ligaments, was then isolated by one division of the ligaments and parietal relationship. Interrupted mattress sutures of chromic No. 2, double, in interlacing layers were passed through the outline of the pyramidal area in the liver. The entire mass was then removed with the aid of an electric cautery.

Hemostasis was perfect, with very little loss of blood. The edges of both sides of the liver were approximated with chromic gut sutures and the raw surface further covered by utilization of the remaining falciform ligament and omentum. The area was then drained as follows—a Mikulicz pack consisting of one rubber dam with four pieces of iodoform gauze was placed at the inferior surface of the liver. One cigarette drain was inserted in the lesser sac, one in Morrison's pouch and one in the subphrenic space lateral to the liver. The wound was closed in layers with chromic catgut throughout—continuous for the peritoneum,

interrupted for the anterior sheath and muscle, and retention black silk sutures for the skin.

The postoperative course for the first twelve hours was stormy, but after that the patient continued to improve slowly. The patient was discharged with a draining sinus on the thirty-first postoperative day. During the last two weeks of her stay at the hospital there was a low grade temperature (98.6 to 100 degrees).*

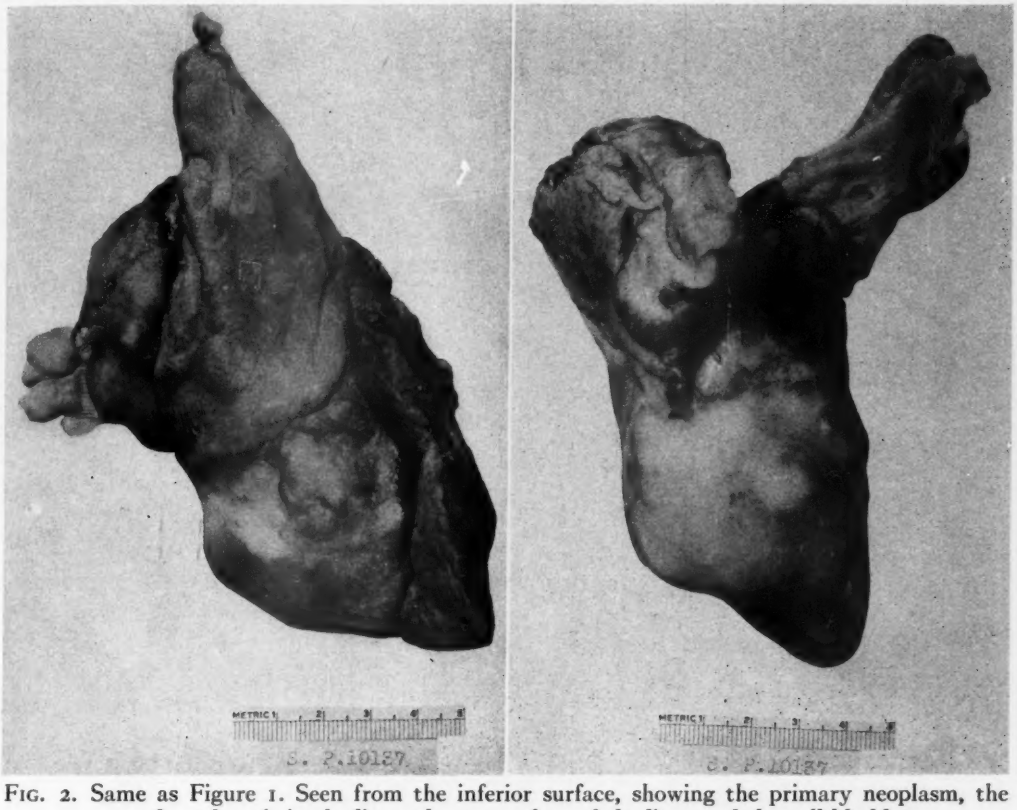

FIG. 2. Same as Figure 1. Seen from the inferior surface, showing the primary neoplasm, the secondary deposit in the liver, the cut surface of the liver and the gall-bladder.

A pathologic report (Dr. Lederer) of the tissue removed was as follows: "The specimen consists of a stony, hard mass 12 × 6 × 14 cm., to which is attached the gall-bladder. (Fig. 1.) Part of the external surface is smooth, discolored bluish-red, the remainder is covered with soft brown tissue. On section the mass is further subdivided into two fairly well circumscribed irregular nodules, 5 cm. in diameter and 3.5 cm. in diameter and connected by a bridge of soft tissue similar to that covering the external surface. (Fig. 2.) The cut surfaces of the nodules are composed of a firm outer pearly-gray rim surrounding a central area of firm yellow arborizations, through which pink strands ramify. Encapsulating each nodule is an irregular portion of soft, light brown tissue streaked with red. One end of the larger mass is directly continuous with the wall of the fundus of the gall-bladder. The outer wall of the smaller nodule is closely adherent to the outer wall of the gall-bladder at its fundus. The external surface of the gall-bladder is rough and discolored. The lumen contains ten soft, faceted, combined dark green and yellow gallstones. (Fig. 3.) The mocosa is light green and its pattern is indistinct. The wall of the gall-bladder varies in thickness up to 0.5 cm. At the fundus it is closely adherent to the larger nodule and infiltrated with the yellowish tissue seen in the center of the mass. Sections were taken through the gall-bladder and nodules.

"*Microscopic.* In a preparation from the wall of the gall-bladder adjacent to the tumor mass, the mucosal surface at one end is thrown into coarse and delicate folds covered by tall columnar cells. Here occasional outpouchings of the mucosa are seen in the greatly hypertrophied muscular coat. The connective tissue

*The patient was last seen on December 15, 1938. She was apparently in excellent physical condition, there was no evidence of recurrence, and she had regained 26½ pounds to her normal weight.

of the tunica propria is markedly increased in amount and is infiltrated with small and large mononuclear leucocytes. The intermuscular

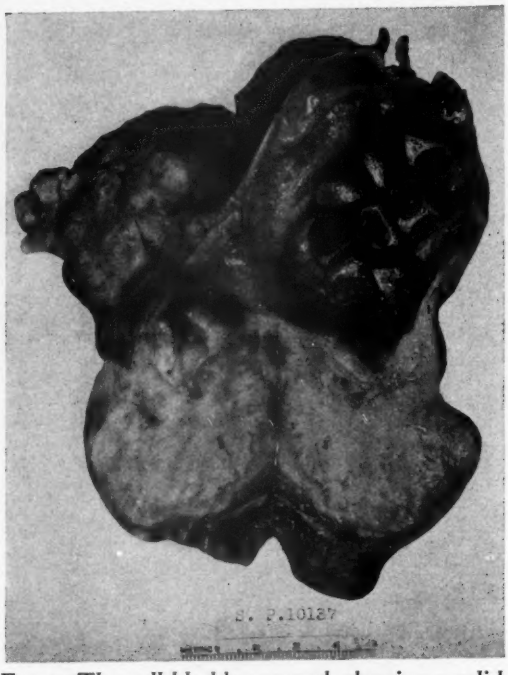

Fig. 3. The gall-bladder opened, showing a solid tumor at the fundus and calculi in the lumen.

to merge with the tumor cells. The latter are large, cylindrical cells, varying in size, shape and chromatic nuclear content—some are giant-sized and occasionally contain two nuclei. They grow in nests, strands and cords, and in some places assume an acinar structure. (Fig. 4.) The stroma is abundant, dense, hyalinized and infiltrated with mononuclear cells, plasma cells, and polymorphonuclear cells. In some areas there are also seen endothelial lined spaces. Extensive areas of necrosis are also present in some regions. Other preparations from the tumor mass show similar changes. The tumor here too, grows in nests, strands and cords and is embedded in abundant hyalinized tissue which is infiltrated as described above. In some of the preparations the areas of necrosis are more extensive than in others.

"The preparation taken from the gall-bladder, remote from the tumor, shows the mucosal surface thrown into folds covered by cylindrical cells. Invaginations of the mucosa are seen extending to the somewhat hypertrophied muscular coat. The connective tissue of the tunica propria, as well as the intermuscular and perimuscular connective tissue,

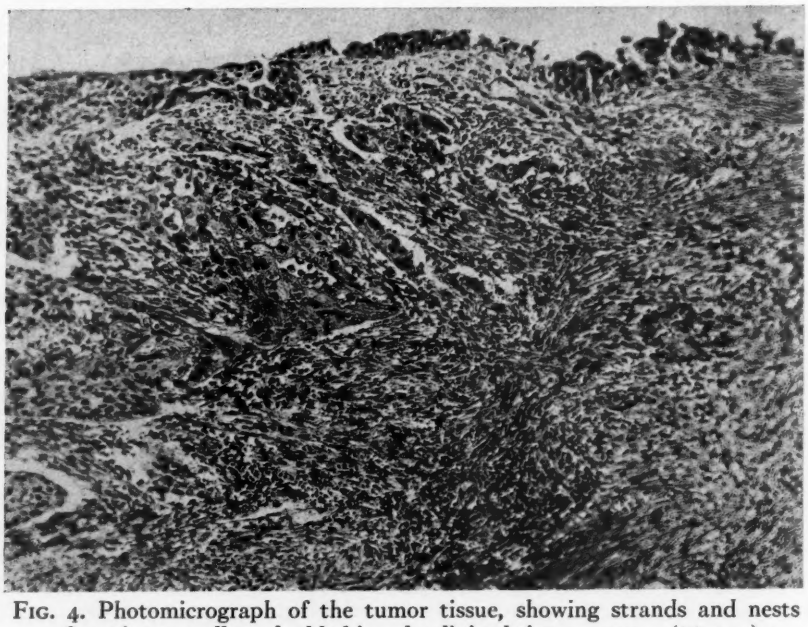

Fig. 4. Photomicrograph of the tumor tissue, showing strands and nests of carcinoma cells embedded in a hyalinized tissue stroma. (× 200.)

and perimuscular connective tissue are likewise increased in amount and similarly infiltrated. In places the cellular infiltration is quite dense. Near the tumor cells lining the mucosa there are some cells somewhat larger and with deeper staining nuclei. In places the lining cells seem

is increased in amount and infiltrated with mononuclear cells, eosinophiles and polymorphonuclear leucocytes.

"In the preparation taken from the liver, the usual cytologic architecture is still well maintained. The sinusoids and veins are dis-

tended. The cells appear large with vesicular nuclei and granular, somewhat vacuolated cytoplasm. In the periportal spaces there is an infiltration of mononuclear cells and polymorphonuclear leucocytes. There is an increase of fibrous tissue and a diffuse cellular infiltration in some places. Tumor tissue is present near the margins of the preparation."

SUMMARY

A case is reported of carcinoma of the gall-bladder with complete removal of the gall-bladder and contiguous extensions to the liver. Thirty-one other cases of carcinoma of the gall-bladder are reviewed with a brief résumé of the recent literature and clinical manifestations of the disease.

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RESECTION OF THE MANDIBLE FOR MEDULLARY OSTEOSARCOMA*

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INTRODUCTION

OSTEOLYTIC medullary lesions of the mandible present difficult problems in early and differential diagnosis. The clinical history and physical examination of the patient may contribute only partly towards a diagnosis. Stereoscopic roentgenograms of the mandible, while identifying the relation of the lesion to the bone and the demonstration of its radiolucency, still may not clarify the distinction between bone cysts, the localized form of osteitis fibrosa cystica, radiculodental cyst, and osteolytic central or medullary osteosarcoma. A third important measure in the establishment of a correct diagnosis is early and conclusive biopsy examination; this test requires experience in the selection of proper tissue for the examination, and even more experience by the pathologist in the identification of the tissue from the biopsy specimen.

The three common types of mandibular sarcoma are periosteal fibrosarcoma, the periosteal osteogenic sarcoma and the medullary osteogenic sarcoma. The periosteal fibrosarcoma is a tumor arising from the fibrous layers of the periosteum. Because of the absence of osteoblasts, there is no tendency to the production of bone. These tumors, in contrast to the osteogenic group, have little tendency to involve bone, but cause pressure erosion or absorption of contiguous bone. The periosteal osteogenic sarcoma of the mandible also causes an early swelling to appear on the external or internal surface of the mandible, but it also destroys the cortex of the bone. The medullary osteogenic sarcoma, on the other hand, is seldom detected early, because of its central location. This sarcoma is the most frequent type occurring in the mandible. An example of the medullary osteosarcoma and the principles of treatment of this tumor may be illustrated in the following report of a case.

T. M. C., a man aged 30 years, experienced discomfort in the left lower jaw for the first time in July, 1936. On September 23, 1936, following an *x*-ray study of the mandible, the lower left second and third molar teeth were extracted, and an attempt was made to enucleate a suspected cyst involving these two teeth. No identifiable tumor tissue was seen at the time of this exploration, nor during the following three months, while the patient was under observation. On January 11, 1937, roentgenograms were again taken of the lower left mandible. A formal incision was made into the visible cystic cavity, but no tumor was encountered at the time of curettage.

Physical Examination. On February 20, 1937, an intraoral examination revealed a soft, localized mass involving the left sublingual region and fusing into the lingual plate of the mandible. This mass extended over a region from the lingual surface of the first molar tooth distally to the retro third molar space and from the gingival border of the lingual surface of the mandible deeply into the soft tissues of the floor of the mouth. Palpation of this mass elicited tenderness on pressure, but not actual pain. The lower left second and third molar teeth were absent, with a completely healed surface over the crest of the mandibular ridge. No signs were demonstrable extraorally except some slight inflammation in the left submaxillary gland.

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Roentgenologic Study. An *x*-ray examination showed a spherical, well demarcated radiolucent cavity, about 2.5 cm. in diameter.

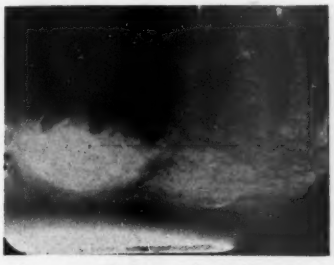

Fig. 1. *X*-ray taken September 16, 1936 which preceded the extraction of teeth. Radiolucent area is shown involving the second and third molar teeth.

This extended from the distal border of the first molar tooth to the angle of the mandible and from the crest of the alveolus to the lower border of the mandible, so that only the cortical plate of the bone remained intact.

Fig. 2. Roentgenogram of mandible revealing the location of the osteolytic tumor.

Diagnosis and Treatment. An aspiration biopsy made at this time obtained tissue which was not diagnosed as tumor. Because of the history of profuse bleeding following the previous incision and curettage of the lesion, together with its progressiveness, the presumptive diagnosis was made at this time of an hemangioma of the bone, or a telangiectatic variant of osteitis fibrosa cystica.

Fractionated doses of high voltage *x*-rays were given to one external field directed toward the tumor. The factors of treatment were

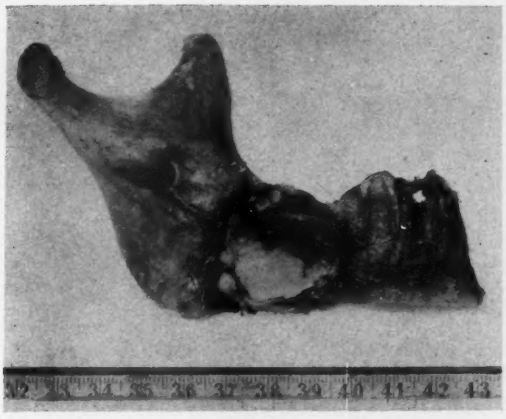

Fig. 3. Resected mandible showing the tumor in position.

Kv. 200, filter ½ mm. of copper and 1 mm. of aluminum, target-skin distance 62 cm., size of field, 5 cm. cone, dose 200 r daily, administered on consecutive days until a total dose of 3,600 r were administered.

The Roentgen therapy was completed by April 1, 1937, and before that time the external swelling of the mandible had entirely disappeared. There was some residual tumefaction on the inner aspect of the horizontal ramus posteriorly, but this had disappeared by May 1, 1937. Stereoscopic roentgenograms of the mandible made on May 22, showed that osteogenesis was proceeding satisfactorily; the bony defect was closing and there was increased density of the surrounding normal bone.

The patient did not return for his next specified appointment in June 1937, and it was not until October 23, five months following his last examination, that he presented himself for further observation. Roentgenograms taken at this time revealed a more extensive radiolucent area in the medullary cavity of the mandible, with progressive erosion of the surrounding bone. Physical examination showed an increased swelling of the tissues over the medial aspect of the horizontal ramus of the mandible, and extending deeply toward the lingual margin. The patient had experienced discomfort during mastication, and some pain referred to the left temporomandibular articulation.

An aspiration biopsy was taken on October 28, 1937. It was diagnosed by Dr. Fred Stewart

as a malignant spindle-cell sarcoma, presumably medullary osteogenic sarcoma of the mandible.

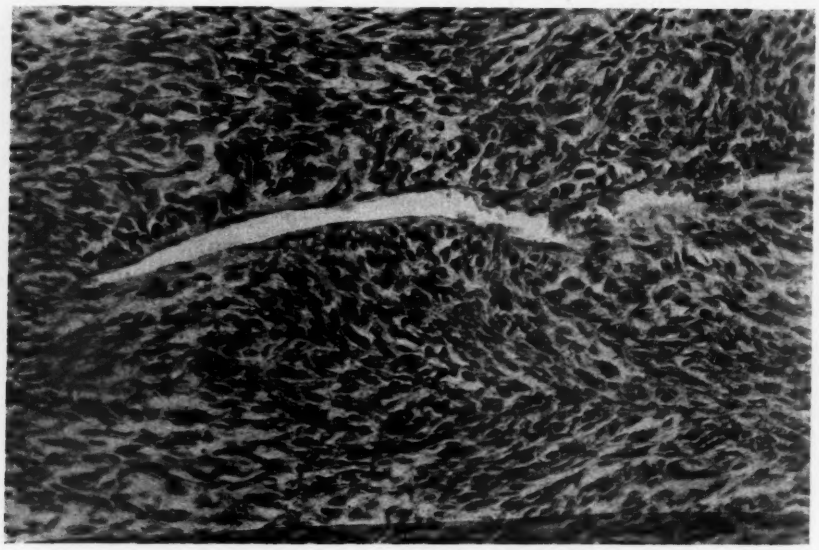

FIG. 4. Photomicrograph of medullary osteogenic sarcoma.

On November 5, 1937, interdental wires were placed in position on the teeth of the right mandible and maxilla preparatory to resection of the left mandible and subsequent approximation of upper and lower jaw. The operation for resection of the left mandible was performed on November 6 under avertin anesthesia, supplemented with endotracheal ether. The operation was preceded by ligation of the external carotid artery for the control of hemorrhage. It was carried out entirely within the mouth. The mucoperiosteal flaps were made along the crest of the gingiva, beginning at the lateral incisor tooth and extending distally up the anterior border of the ramus. The lower left two bicuspid and first molar teeth were extracted. The mandible was partly exposed from the periosteum both lingually and buccally by blunt dissection. A Gigli saw was then passed lingually along the distal border of the lower left cuspid tooth and, by an extraoral puncture of the skin, was carried through to the outside. The mandible was then severed by the saw along the distal margin of this tooth. The masseter and internal pterygoid muscles were detached by sharp dissection. The more deeply situated temporal and external pterygoid muscles were then detached at their insertion, thus exposing the tumor mass. The capsule of the temporomandibular joint was now incised, and the condyle separated from its fossa. The mucous

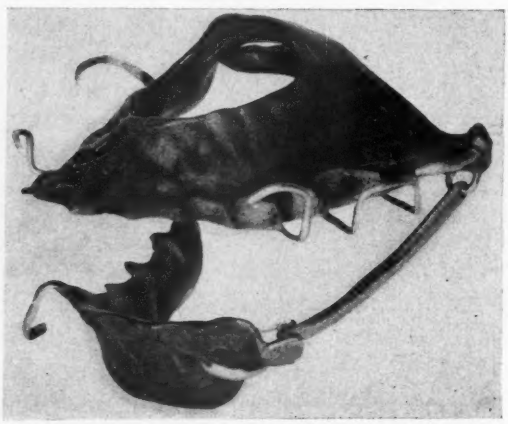

FIG. 5. Prosthesis with joint arrangement to hold upper and lower jaws in alignment.

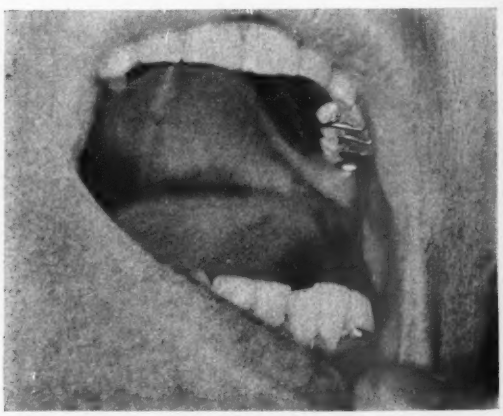

FIG. 6. Prosthetic appliance in position.

membrane was partly coapted and sutured. Iodoform gauze was placed into the deeper portions of the wound, with a second section of plain gauze over this first packing. Very little postoperative bleeding was encountered.

Twenty-four hours after the operation the interdental wires were connected by intermaxillary wires and in this way the remaining portion of the mandible was held in a stabilized occlusion. The first gauze packing was removed within forty-eight hours following the operation. Oral cleanliness was maintained by daily irrigations with saline solution, alternated with potassium permanganate 1:5000 solution. The diet consisted of high caloric liquids, administered through a nasal feeding tube for the first twenty-four hours, and then by an oral feeding for the first two weeks.

Pathologic Report. The specimen consisted of the lower left mandible, apparently separated at the mental symphysis. The inner portion of the middle third of the horizontal ramus was occupied by a tumor which had eroded and replaced the outer table of the bone over an area measuring 1.5 cm. in diameter. The tumor tissue was white and soft. On sectioning, the tumor tissue was found to involve the medullary portion of the bone. It was well demarcated and surrounded by a thin capsule.

Microscopic study by Dr. A. H. Davis revealed spindle-shaped tumor cells in a palisade arrangement. An occasional mitotic figure was found. In some foci the tumor cells were very closely packed together, whereas in other locations they were widely separated by hyalinized fibrous tissue. Sections prepared from the margin of the tumor showed a thin capsule composed of dense fibrous tissue which was infiltrated in many regions by the tumor cells. There was no evidence of bone formation in any sections made from the tumor proper.

Subsequent Course. The upper third left molar tooth was extracted, because it irritated the cheek. All wires were removed from the teeth by January 4, 1938. Two months following the operation, a prosthetic appliance was placed in position for retaining the remaining portion of the mandible in a functional position during the opening and closing of the jaws. This hinged clasp connecting an upper and lower plate attached to the teeth is shown in Figures 5 and 6. The patient was last observed on September 20, 1938, at which time there was no evidence of recurrence. No external scarring could be seen, and the functional and cosmetic results were satisfactory, not only to the physician, but to the patient as well.

Fig. 7. Anterior view revealing little deformity. No appliance in mouth.

SUMMARY

A case report is given of a medullary osteogenic sarcoma of the mandible, treated by hemiresection of the mandible. This destructive operation may be performed without mutilation or functional impairment.

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CONSERVATIVE MANAGEMENT OF DAMAGED RENAL TISSUE*

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WHAT we term here as conservative treatment is not meant to apply universally. We mean it as applying only to the cases here reported. We realize that conservatism in one man's hands is perhaps not conversatism in the hands of another.

We wish to call attention to, and emphasize, the fact that our procedures in these cases were governed by more than one factor. In some instances the financial status of the patient influenced the procedure; in other cases the general health and presence of complications, while in some of them the procedure was influenced by the will of the patient.

CASE REPORTS

CASE I. Mrs. B. was first seen in the Baptist Hospital in June 1928, bed-ridden, pale and emaciated, complaining of frequency and dysuria. Five years previously the right kidney had been removed. The preoperative and postoperative diagnosis was tuberculosis. Acid fast bacilli were found in the urine from the remaining left kidney and the bladder. Guinea-pig inoculation was positive.

This was our first case of tuberculosis found in a solitary kidney. Previously we had removed the tubercular kidney when a good kidney was found on the opposite side. There was no evidence past or present of tuberculosis of the lungs.

Since there was no hope in surgery, we decided to treat the patient as a case of pulmonary tuberculosis, and therefore sent her home. She rented an ultraviolet lamp. She was exposed daily to the rays of this lamp at a distance of 30 inches over the entire body. The exposure began with one minute, and increased one minute per day up to twenty minutes. During this time she was on forced feedings, and had complete rest in bed.

After six months of this régime she was able to be up part of the time, and made a visit to the office. Within nine months, she was doing part of her house work. After eighteen months had expired she considered herself normal. For the past six years indirect reports indicate that she is enjoying perfect health.

CASE II. L. K., a white female, age 28, entered St. Thomas Hospital complaining of frequent attacks of pain beginning in the left shoulder and radiating to the left kidney region. Attacks usually lasted about a week.

Physical examination was negative except for tenderness to deep pressure over the left kidney region. Upon cystoscopy, a No. 6 catheter passed to the right kidney pelvis, but met obstruction on the left about 2 cm. from the left ureteral orifice. Right pyelogram was normal and cultures negative. A left pyelogram was suggestive of tuberculosis, because of the moth-eaten appearance of the lower calyces. A guinea-pig test was positive on the left for acid fast bacilli.

The patient was unable to rent or buy an artificial sunlight lamp, and she was therefore advised to lie in the sunshine naked. She had a special arrangement built in the back yard of her home, went home every day from her office and exposed her entire body to sunlight beginning with one minute and increasing to twenty minutes per day. It was fortunate that during August and most of September that year the sun continued to bless that portion of Tennessee. She soon felt better. During her sunbath treatment she was on forced feedings and stayed in bed every minute she was not working in the office. She gained 19 pounds in two months.

Correspondence about every six months has revealed that she is well and happy.

* Presented before the Section of Genitourinary Surgery, New York Academy of Medicine, March 17, 1937.

Some time ago I wrote her and asked her to come in for a check-up (without cost to her). She replied, "I never felt better in my life. I have been out of the office only two days in the past five years, and will see you some time if business calls me to Nashville."

Fig. 1. Case III. Pyelogram of the right kidney showing wide dilatation of the right kidney pelvis. Note the enormous stretching of the minor calyces.

Fig. 2. Three months later, showing return of minor calyces to normal but still some enlargement of the kidney pelvis.

Case III. J. M. C., white male, age 29, a policeman, entered hospital October 31, 1935, with a typical attack of renal colic on the right side, of one week's duration. He had been treated by his local doctor during this period with opiates. The pain originated in the right kidney region, radiated medially and downward to the bladder, to the right testicle and thigh. He had frequency, urgency and hematuria. His past history was negative except for a fracture of the lumbar spine in 1932.

Catheters passed easily to both kidneys. Urine escaped in a stream from the right kidney, which, when decompressed, could not be palpated. This relieved the patient of pain. *X*-ray revealed a large hydronephrosis on the right. Two days later the patient went home, and in forty-eight hours he returned with symptoms of obstruction in the right ureter, a temperature of 104, pulse 130, respirations 20. Pyelogram revealed a massive hydronephrosis with wide dilatations of the minor calyces. Nephrectomy was considered. (Fig. 1.) Drainage of right kidney again relieved him and his temperature dropped to normal in a few days.

He had frequent cystoscopies over a period of two months, during which time he passed three stones, two of which were alike, the third darker in color. A recent pyelogram reveals the right kidney pelvis has returned almost to normal, especially the minor calyces. (Fig. 2.)

This case is presented not so much as an example of conservatism, but as an example of how the kidney can restore itself.

Fig. 3. Case IV. Pyelogram showing what appears to be a dead kidney. This kidney regained 40 per cent function without any change in the picture as shown by pyelogram.

Case IV. E. M. K., age 56, unmarried female, very obese, was seen on May 27, 1936.

She complained of attacks of pain in the right kidney and suprapubic region, accompanied by chills, fever, frequency and dysuria.

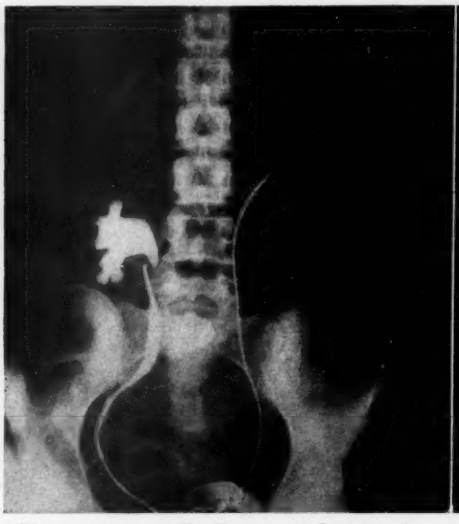

Fig. 4. Case v. Pyelogram taken in the erect position before nephropexy.

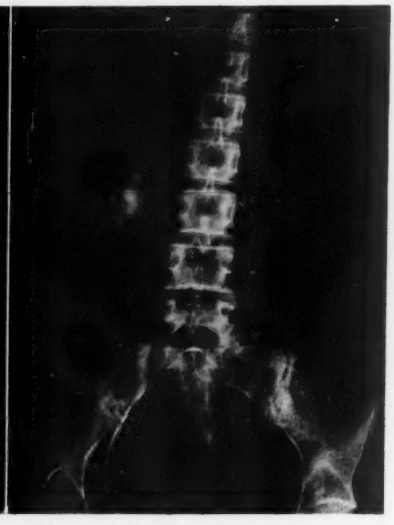

Fig. 5. Pyelogram, erect position three months after operation.

Cystoscopy revealed nothing but pure pus from the right kidney, which was under high pressure. The amount of pus drained from the right kidney pelvis at the first cystoscopy was 50 c.c.; no urine was obtained. The right kidney pelvis was lavaged once weekly for five weeks. The amount of pus decreased and the amount of urine increased.

The patient is now able to go for one month or more without lavage, and the last three cystoscopies have revealed only a small amount of pus in the urine.

It is noticeable in this case that though the symptoms have cleared up and function has been restored, the pyelogram did not change in character. (Fig. 3.) Nephrectomy was advised but the patient refused operation. Now by conservative methods we are able to keep her on her job as a clerk.

Fig. 6.

Fig. 7.

Figs. 6 and 7. Stone obstructing lower left ureter.

Case v. Mrs. P. V., age 32, married with three children, entered the Nashville General Hospital January 6, 1937, complaining of a

movable mass in the right side. She had had intermittent severe colic on that side which she could relieve by standing on her head. She had frequency and urgency with these attacks but no chills. These attacks of colic occurred once or twice each month for two years. Her past history was essentially negative except for removal of a cervical polyp May 27, 1936.

Physical examination revealed a thin pale woman of 32. Heart and lungs were negative. The right kidney was felt slightly enlarged and tender just above the superior spine of the ilium. It was fairly movable.

The white blood cells numbered 9,000. Urinalysis and urine cultures were negative. N.P.N. was 35; P.S.P. of the right kidney was 1 per cent and of the left kidney 14 per cent in ten minutes.

At cystoscopy the bladder appeared normal and catheters passed easily to the pelves of both kidneys. Specimens from the two sides were normal. Pyelogram on the right side showed nephroptosis, hydronephrosis, and kink. (Fig. 4.) A nephropexy was done January 18, 1937, and a pyelogram three months later showed the kidney in normal position (Fig. 5), the hydronephrosis relieved, and normal function on that side.

The patient has been well and free of symptoms since she left the hospital February 8, 1937. This patient was not benefited by a belt, because the kidney was too low to insert a pad below it.

Case vi. L. D., white male, seven years ago presented himself with a complaint of left sided renal colic. *X*-rays showed a stone in the left ureter. (Fig. 6.) He would not agree to surgery, but went off to Kentucky to buy medicine from a quack which was guaranteed to dissolve stones. About three months ago he returned. *X*-rays showed that the stone had moved downward to within 2 inches of the ureteral orifice. (Fig. 7.) By this time he had lost a great deal of weight, was suffering with general malaise, loss of appetite and frequent attacks of chills and fever.

The stone was removed through an abdominal incision. When the ureteral wall was opened and the stone plug removed, at least three pints of liquid heavily loaded with pus escaped under moderate pressure. Two months after operation a pyelogram was made. The capacity of the left kidney was 50 c.c. (Fig. 8) and P.S.P. excretion was 5 per cent in ten minutes.

Two months after operation he was seized with violent renal colic on the right side, and for four days was very ill with acute pyelitis.

Fig. 8. Case vi. Pyelogram of the left kidney which had no function following operation, but which had regained a P.S.P. return of 5 per cent in ten minutes three months after operative removal of calculus shown in Figure 7.

We feel that his right kidney might not alone have been sufficient to furnish the necessary kidney function.

This case demonstrates how much punishment a kidney can sometimes take, and yet regain an amazing per cent of normal function.

Case vii. On April 19, 1929, H. W., a colored man of 25, presented himself at the Vanderbilt hospital complaining of pain in the sides and back and hematuria. He stated that he had been passing blood from his bladder for two years intermittently, and that occasionally clots would obstruct the urethra.

He was studied with a view to determining the etiology of the bleeding. His blood picture and blood calcium were normal. Guinea-pigs inoculated with specimens of the urine failed to die of tuberculosis. At frequent cystoscopies bleeding was observed to come from both ureteral orifices or more often one orifice at a given observation. Repeated pyelographic studies failed to reveal evidence of any abnormality along the ureter or in the region of the kidneys that would account for the hematuria. Kidney function tests taken in intervals when there was no bleeding revealed the kidney function to be normal on the two sides.

This patient was followed for a period of four years during which time there were periods of profuse bleeding, light bleeding and no bleeding. On more than one occasion transfusions were resorted to as a life saving measure. The right kidney alone produced the hemorrhage six times, the left alone one time and on several occasions both kidneys bled simultaneously.

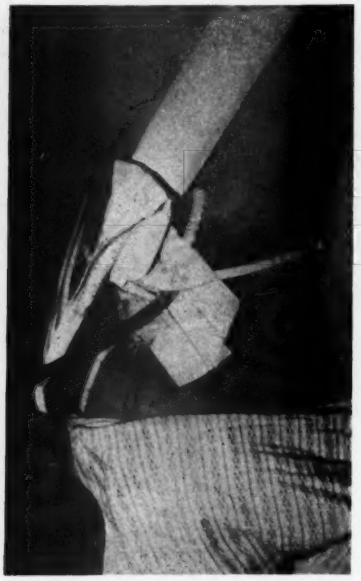

Fig. 9. Catheter from pyelotomy opening draining into a rubber bag. For two and one-half years this patient has been able to work, collecting his urine in this manner. He has only the left kidney (congenital) and passes no urine from the bladder.

When first seen this patient was bleeding from the left kidney alone and nephrectomy was delayed only because no reason could be found for the bleeding. We feel that if nephrectomy had been done we surely would have lost the patient during his attacks of bleeding from the right kidney. We cite this case as a caution against nephrectomy in hemorrhage of undetermined origin.

Case VIII. H. L. M., male, age 35, was seen in August 15, 1934 in consultation with Drs. Teachout and Magruder of Nashville, by whose permission it is now reported.

The chief complaint was painful swelling in the left abdomen. For the past year there had been intermittent swelling in the left side of the abdomen, accompanied by pain. Attacks occurred at intervals of a few weeks and lasted as long as a week. The swelling involved the entire left half of the abdomen at times, but was most pronounced just below the costal margin. It was tender, firm and slightly movable. Attacks were accompanied by frequency and hematuria, consisting of bright red blood clots. Between attacks the patient felt weak, "fagged out" and extremely nervous. The swelling did not entirely disappear, but a mass about the size of a hen's egg could be felt all the time. Five cystoscopies and one intravenous urogram had all failed to show the presence of a right kidney.

Fig. 10. Case VIII. Pyelogram of congenital solitary kidney. Note the marked hydronephrosis and hydroureter. There is evidence on other plates that this ureter passes upward and medially to enter the bladder, thus passing behind the vena cava.

The patient had suffered during childhood with incontinence of urine. In 1921 he was thrown by a mule and had hematuria for three days. In 1927 he had an attack of acute pain in the left kidney region. Physical findings showed a large, exquisitely tender, slightly movable mass, filling the entire left side of abdomen.

Intramuscular injection of phenolsuphonephthalein was followed by return of 1 per cent in the first hour, 1 per cent in the second and 2 per cent in the third, a total of 4 per cent in three hours, with 725 c.c. of urine. N.P.N. was 67 mg. per 100 c.c. The white blood count was 6,600.

A second P.S.P. one week later showed: first hour 5 per cent; second hour 10 per cent; third hour 5 per cent, a total 20 per cent in three hours, with 550 c.c. of urine. The N.P.N. was 60 mg. per 100 c.c.

The cystoscope entered easily. The prostate was markedly enlarged from infection and edema. A No. 6 catheter seemed to pass all the way to the left kidney pelvis. Nothing would enter the only thing which seemed to be the right ureteral orifice. Fluid dripped rapidly from the left catheter, until 300 c.c. had been drawn off, then the flow decreased. Cultures were negative for ordinary pyogenic organisms. Attempts were made to do a pyelogram and a pyelo-ureterogram on the right, but the catheter was blocked.

The temperature had been ranging from 98.6 to 99.4. Next day, after cystoscopy, it was 104.2. The patient was desperately ill and the kidney could not be drained with a catheter. Surgery was imperative.

A lumbar incision was made down to the kidney, and the kidney stabbed. Fluid shot about 3 feet high and ran all over the patient and operating room floor. It was estimated that there was a gallon or more. The kidney wall was about $\frac{1}{16}$ inch in thickness. A Pezzer catheter was placed in the kidney. The temperature dropped to normal in four hours and then ranged from normal to 103 for four days, after which it remained normal.

The patient left the hospital on the twelfth postoperative day, wearing the Pezzer catheter with a hot water bottle to receive drainage from it. He soon changed to a straight catheter instead of the Pezzer. He and his wife have given the necessary care.

For two and one-half years he has been in perfect health and has bought, paid for and managed a grocery store. (Figs. 9 and 10.) He passes no urine from his bladder, depending entirely on the catheter he wears in the pyelotomy opening.

SUMMARY

We thought it might be of interest to present some cases which, due to factors beyond our control, made conservatism a necessity. Also, some cases in which conservatism is the method of election. We wish it understood that we do not advocate palliative treatment in renal tuberculosis except in cases where it is a necessity.

One cannot overemphasize the "comeback" ability of renal tissue following removal of the causative factors of damage. This is especially true in mechanical obstruction of the ureters as seen in ureteral calculi. An analysis of the kidney response in cases as cited above is often of great help in making a vital surgical decision. Damaged renal tissue can often be nursed back to health but when removed is forever lost.

SPONTANEOUS PERIRENAL HEMATOMA (SUBCAPSULAR)

CASE REPORT

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PERIRENAL hematoma is a disease of very rare occurrence, few cases having been reported in literature. There are on record sixty-four cases of subcapsular perirenal hematoma since Raye, in 1839, first described this condition. Wunderlich, in 1846, gave a rather comprehensive account of this condition and termed it renal apoplexy.

Several authors do not recognize perirenal hematoma as a distinct entity, but believe that it is always associated with alterations of the kidney or its capsule.

Greco[1] classifies perirenal hematomas as (1) subcapsular; (2) extracapsular; and (3) mixed. The kidney itself may be perfectly normal or it may show ischemic areas due to pressure, congestive lesions of varying degrees, or small cortical or subcapsular hemorrhages. Coenen[2] speaks of subcapsular or perinephritic hemorrhages, comparing them with the disease hemorrhagic pachymeningitis, the etiology of which is also obscure.

Etiologically these cases fall within the following groups:

1. Disease of the renal parenchyma and smaller blood vessels, neoplasms, tuberculosis, pyelonephritis, polycystic disease, typical anemic infarcts, arteriosclerosis of the perirenal vessels, and possibly periarteritis nodosa, as in the case of Weaver and Perry.[3]

2. Extrarenal retroperitoneal causes, namely: aneurysms of abdominal aorta, renal or spermatic arteries or hemorrhages from the adrenal vessels.

3. Hematomas associated with blood dyscrasias, such as hemophilia, thrombopenic purpura, and polycythemia.

Clinically, one must distinguish between acute and chronic forms.[4] The acute form is characterized by sudden pain of great severity usually generalized over the entire abdomen, most exquisite in the lumbar region. The picture is that of an acute surgical abdomen plus signs of internal hemorrhage. Later the pain may radiate downwards or upwards, simulating renal or ureteral calculus. Internal hemorrhage manifests itself by the usual signs of pallor, rapid thready pulse, thirst, restlessness, air hunger and dyspnea. The blood picture shows a marked reduction of hemoglobin and red blood cells. A tumor mass usually forms over the kidney region in four to twelve hours—this is one of the cardinal findings in cases of perirenal hematoma. The mass is often visible on inspection and practically always palpable, usually down to the crest of the ilium. The mass is smooth, regular, elastic, and sometimes fluctuant. Peritonitic symptoms of vomiting, rigidity and obstipation follow only the vastest extravasations. In general, the urine is of little value for diagnostic purposes. The majority of cases show albuminuria, probably due to pressure of the hematoma on the kidney substance. Hematuria is rarely present in the subcapsular type of perirenal hematoma.

In the chronic form the onset is more insidious, the hematoma forming slowly in two days to several weeks. Unlike the acute form, the pain is colicky in nature and not so severe. The patient usually feels a sense of weight or fulness in the affected lumbar region, which may be the only symptom present. Symptoms of acute internal hemorrhage and shock are much modified or absent in the chronic form. In some cases of a chronic nature, the onset often remains unobserved. The lesion may be tolerated for an entire lifetime and be observed only

as a surprise finding at the operating table or at autopsy.[5]

Correct preoperative diagnosis is often difficult. Temperature may be elevated following reabsorption of part of the extravasated blood or secondary infection. The most frequent tentative diagnoses are intestinal obstruction, perirenal abscess, or kidney tumors. Lenk[6] described a classical triad of abdominal pain, progressive pallor (due to internal hemorrhage), and the presence of a tumor mass in the kidney region as diagnostic of perirenal hematoma.

Prognosis in the acute form is very poor, with or without surgery. According to Greco the mortality of operated cases is over 50 per cent. In the majority of acute cases death is due to hemorrhage or secondary renal infection. Prognosis in chronic forms is less grave, about 22 per cent.

Expectant treatment is almost invariably fatal, surgical procedures offering the best chance for recovery. Evacuation of the clot with tamponage, and drainage has a mortality of 40 per cent, while nephrectomy carries a mortality rate of 22 per cent.

Fig. 1. Showing outline of huge left kidney.

The authors recently had occasion to observe and operate on a large perirenal hematoma of two months' standing.

A white female of Russian descent, age 46, 5 feet 6 inches tall, weighing 140 pounds, had enjoyed good health prior to 1933, when she had a hysterectomy and an appendectomy with apparent complete recovery. She gave a history of having had the usual childhood diseases. Venereal disease was denied. She was a para 3, and had had no stillbirths, miscarriages, or abortions. The children were all living and well.

The present illness began in November 1936. While attending her housework she experienced

a severe knifelike pain in the left lower abdominal quadrant, which became generalized. She immediately took soda, but obtained no relief. She was forced to lie down for six hours because of her pain. As she lay on her left side, the pain radiated to the right lower quadrant and epigastrium. She became nauseated, vomited twice, and had a slight chill which lasted about five minutes.

Pain and nausea lasted several hours, and then the acute pain subsided. On arising several hours later, she experienced a feeling of heaviness in the left kidney region. When questioned closely, the patient stated she felt no mass, but experienced a marked tenderness over the left lumbar region on light pressure. From that time until she was hospitalized she had attacks of colicky pain in the left renal region every six or seven days. Pains were present only on physical exertion. She had no nausea or vomiting after the initial attack. About two months after the attack, while dressing, she felt a mass in the left lower quadrant just above the crest of the ilium. She stated that it was sore to the touch and she felt nauseated when the mass was palpated. She at no time complained of hematuria, dysuria, polyuria or frequency of urination. There was no history of trauma at any time.

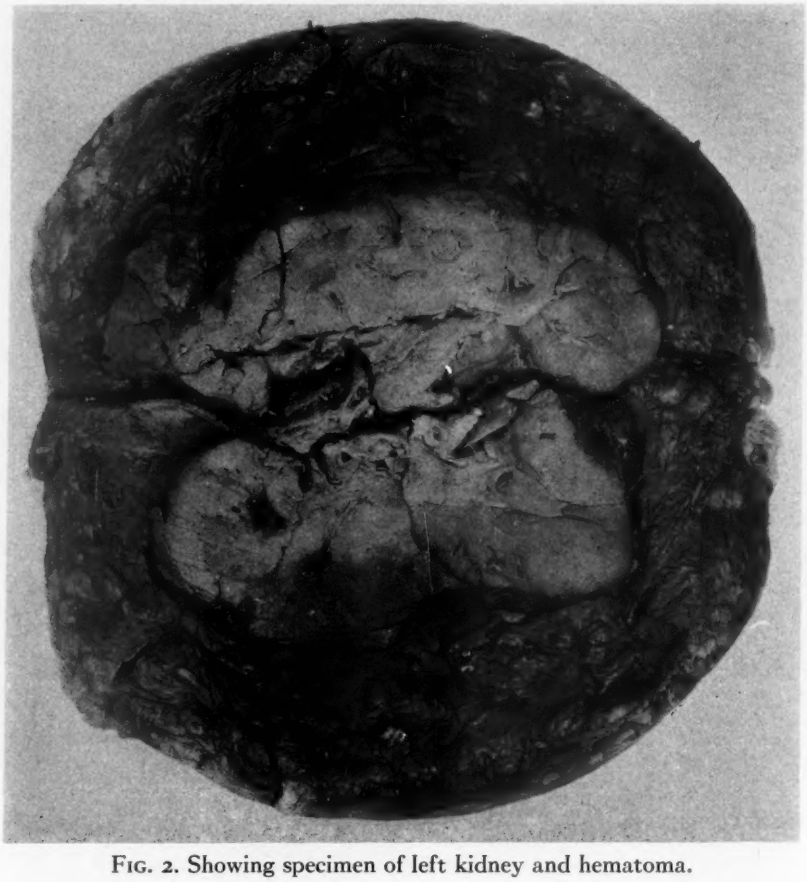

Fig. 2. Showing specimen of left kidney and hematoma.

We saw this patient for the first time on January 17, 1937, palpated the mass and hospitalized the patient the same day. A more detailed history showed that the patient had lost her appetite since the initial attack. She complained that "food would not go down." She had an emesis following each meal for two weeks previous to hospitalization. She lost 15 pounds in weight, probably due to the fact that she was unable to retain food.

Physical examination revealed a well nourished, white adult female, who appeared not acutely ill. She entered the hospital with a temperature of 101 degrees rectally, blood pressure of 140/80, pulse of 100 and respirations of 22. Head and scalp were negative. The pupils reacted to light and accommodation. The sclera was normal, no jaundice. The ears were essentially normal with no discharge and normal

hearing. In the mouth there was an upper plate, with the lower teeth in good condition. Tonsils were present and normal. The tongue was coated. There was no cervical adenopathy, no visible pulsations of the neck, no enlargement of the thyroid. The chest revealed normal and equal expansion. The breasts were soft with no tumors palpable. Fremitus, resonance and breath sounds were normal and there were no râles present. The heart was within normal borders, its rhythm regular, and no murmurs audible.

Inspection of the abdomen revealed a slight elevation of the left lower quadrant which when palpated revealed a mass the size of a large grapefruit, extending from the costal margin on the left side down to the crest of the ilium. It was round, hard, smooth, very tender, immobile and not fluctuant. Liver and spleen were not palpable. There was no ascites but a marked tympanites was present.

Extremities revealed no evidence of a loss of subcutaneous fat. There were no varicosities, no ulcerations or scars. Vaginal examination was negative, and no tears were present. The uterine fundus was absent. No rectocele or cystocele was present. Rectal examination showed no fissure, hemorrhoids or fistulas.

The specific gravity of the urine was 1.020. No sugar was present, but there was 3 plus albumin. Microscopic examination revealed 100 white blood cells per high power field, a few epithelial cells, and 10 to 20 red blood cells.

Blood analysis revealed a hemoglobin of 70 per cent; R.B.C. 3,700,000; and W.B.C. 11,650. There were 10 per cent small lymphocytes, 13 per cent large lymphocytes, 74 per cent polys, 2 per cent eosinophiles and 1 per cent transitionals. The coagulation time was four minutes.

Cystoscopic examination disclosed inflammation of the trigone and vesical neck. The right ureter appeared normal, the left ureter inflamed. Phenophthalein appeared from both sides within four minutes. A total of 45 per cent of the dye was eliminated in fifteen minutes. The kidney pelvis of both kidneys was essentially negative. Specimen of urine from the left kidney showed many red blood cells and leucocytes. The urine from the right kidney was negative.

In attempting to establish a diagnosis, a barium enema was given and a flat plate taken. (Fig. 1.) The roentgenogram showed a mass posterior and mesial to the descending colon, which was apparently a huge left kidney, reaching to the crest of the ilium and extending well into the flank. There were no shadows suggestive of calculi. The outline of the left kidney was smooth and regular, and the right kidney was larger than usual. The large bowel showed no masses or constrictions, the barium passing freely through the entire colon.

It was therefore concluded that this patient was suffering from a large mass in the left retroperitoneal space, a hypernephroma of the kidney being the first consideration. A second diagnosis was retroperitoneal tumor, in all probability a malignancy.

An exploratory operation was performed on January 21, 1937, under spinal anesthesia, 200 mg. of novocaine being used. Because of the huge size of the tumor a transperitoneal T-shaped incision was made over the outer border of the left rectus muscle. The posterior peritoneum was separated from the kidney capsule by blunt dissection and packed away from the operative field. Further exploration revealed a smooth, firm, symmetrical tumor, the size of a large grapefruit, and immovable. It was bound down by what appeared to be freshly formed adhesions which were easily destroyed with the finger, and the mass was delivered out of the renal bed. No aneurysms were found in the renal pedicle. Because of the shortness of the pedicle no attempt was made to place ligatures around it. The pedicle was doubly clamped, cut above the clamps and the mass removed. The clamps were allowed to remain on the kidney pedicle, being gradually released each day, until the fourth day when they were removed. The abdomen was closed in the usual manner with a small drain placed in the kidney bed.

The specimen weighed 956 gm. and measured $19 \times 12 \times 9.5$ cm. It consisted of a kidney with perirenal fat and adrenal gland. The medulla of the adrenal gland was soft. Incision of the kidney showed a large hematoma 7 cm. in diameter beneath the capsule. There was some liquefaction and partial organization. The blood infiltrated the fat. The renal cortex was 1.5 cm. in thickness, and had well defined markings. The calices were well defined and not dilated. The vessels gaped on cut surfaces. There was grossly no new growth. Microscopic examination revealed well defined renal tissue, marked thickening of the

arterioles and perivascular lymphocytic infiltration.

The postoperative course was uneventful and the patient was discharged on the fourteenth postoperative day.

CONCLUSIONS

The points of importance in this case were:

1. Normal kidney function.
2. Sudden onset with no history of trauma and no evidence of internal hemorrhage.
3. Repeated hemorrhage which no doubt took place over a period of two months. Detection of the mass only at the end of that time, illustrating the chronic form of subcapsular hematoma.
4. No gross or microscopic evidence of hemorrhage of the kidney except that the perirenal vessels showed arteriosclerosis.
5. Lenk's triad of pain, pallor and renal tumor not always obvious.
6. Acute intra-abdominal catastrophes call for a consideration of perirenal hematoma.

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Science, very briefly, is a way of looking at nature, in so far as that is possible, exactly. . . . Research represents the effort men make to increase their comprehension. (Cohn)

PRIMARY CARCINOMA OF THE JEJUNUM

REPORT OF CASE

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PRIMARY carcinoma of the jejunum is of rare occurrence, although it is difficult to determine the actual number of cases in which such a diagnosis has been made because statistics pertaining to autopsy or operative findings in carcinomas of the three divisions of the small intestine are generally grouped together. According to Plunkett, Foley, and Snell[1] of the Mayo Clinic, the most common type of lesion is the annular constricting adenocarcinoma which invades all coats of the bowel. Carcinoma of the small intestine, according to reports in the literature, comprises from 1 to 3 per cent of all carcinomas of the intestine. Of the Mayo Clinic series, 41 per cent were located in the jejunum, and Carter[2] has found that 72 per cent of carcinomata of the jejunum are located in the first 12 inches.

It is very difficult to establish the diagnosis before operation, but an obstructing lesion can easily be demonstrated by *x*-ray studies. The symptoms are those of chronic or acute obstruction and vary with the location of the lesion. In practically all cases there is vomiting, weakness, and loss of weight.

The only treatment is resection of the lesion, and, where this is impossible, an anastomosis around the lesion will give temporary relief. The prognosis is variable. In early cases, the patients may recover after resection. No patient in the Rankin and Mayo series[2] lived longer than three years, the average being one year after the establishment of the diagnosis. Death is usually due to cachexia or obstruction.

REPORT OF CASE

The patient was a white woman, 58 years of age, who was married and the mother of two children. The family and past history revealed nothing of significance except for idiopathic gastric hemorrhage which had occurred thirty-two years previous to our examination. An appendectomy had been performed thirty years previously. When she came to the Cleveland Clinic, August 24, 1936, her chief complaints were of vomiting, loss in weight, and weakness. She apparently had been in good health until March, 1936, when she began to have attacks of vomiting, preceded by slight nausea; the vomiting gave complete relief. The attacks occurred at any time and did not seem to be related to meals or type of food ingested. Occasionally they would occur at night. The vomitus was usually light or dark green or brown and very bitter. Only occasionally would particles of food be present, although at times she would see food which she had eaten the previous day. Her appetite was good but small amounts of food would fill her up. Frequently the smell of food nauseated her. Since the onset of the present illness, she had had marked constipation; the only laxative which produced a bowel movement was Pluto water, so she resorted to enemata. No jaundice, diarrhea, bloody, tarry, mucous, or clay-colored stools, had been noted. The patient reported no abdominal pains, distress or cramps, but at times she had a feeling of fullness in the epigastrium after eating. Since the present illness began, she had noticed saliva flowing from her mouth at night when she lay on her side. Since the onset, there had been a gradual increase in weakness which had become quite marked. From June 1936 to August 1936, her weight had dropped from 184 to 145 pounds, a loss of 39 pounds.

In 1932, four years previous to this examination, the patient had noticed fulness in her neck and a roentgenogram taken elsewhere revealed a diverticulum of the esophagus in the region of the neck. At times she was able to press food from it.

Physical examination revealed a well developed, fairly well nourished white woman, who

showed evidence of recent loss in weight. The temperature, respiration, and pulse rates were normal, and the blood pressure was 120 systolic and 90 diastolic. The skin and mucous membranes were of normal color and texture. The tongue was clean with neither smoothness nor atrophy. There were no palpable lymph glands. A smooth, firm, egg-sized, freely movable nodule was palpable in the right lobe of the thyroid; no other masses were palpable in the neck. Examination of the heart and lungs revealed no abnormalities. Examination of the abdomen revealed a low midline surgical scar. The walls were flat, soft, and relaxed and there was no tenderness or rigidity. No masses were palpable and there was no evidence of fluid. No further abnormalities were present except for moderate varicose veins of both legs.

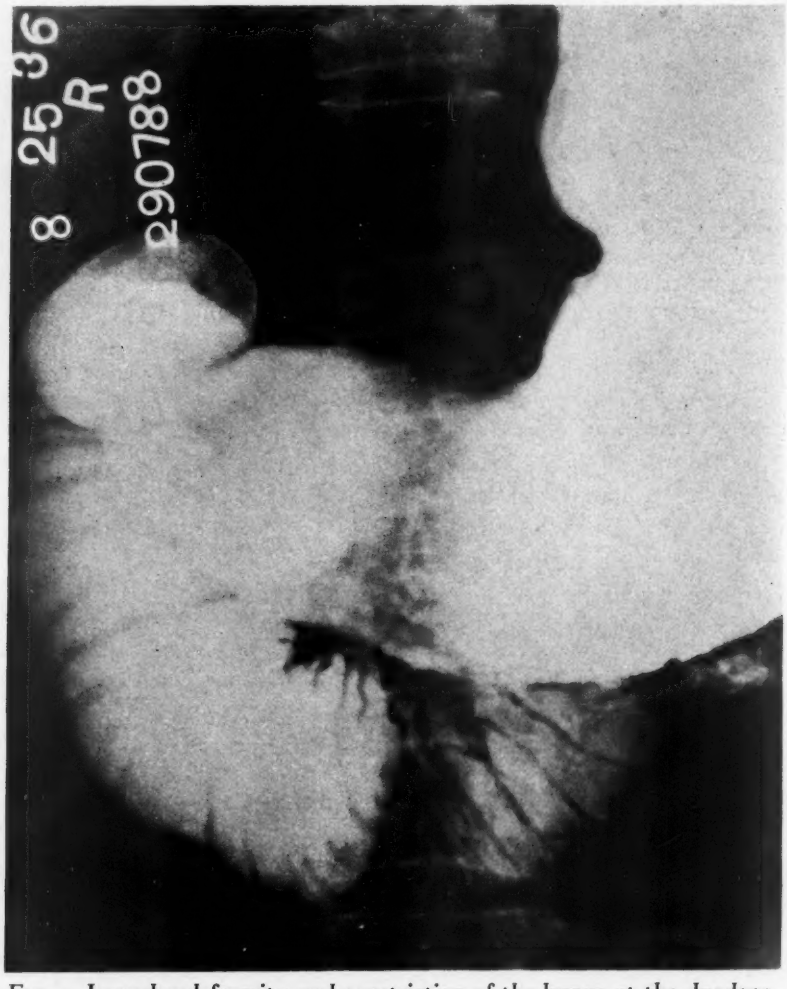

FIG. 1. Irregular deformity and constriction of the lumen at the duodenojejunal junction, causing nearly complete obstruction with marked dilatation of the duodenum proximal thereto.

Roentgen examination (Fig. 1) revealed an irregular deformity and constriction of the lumen at the duodenojejunal junction. This caused nearly complete obstruction with marked dilatation of the duodenum proximal thereto, as well as a moderately large pharyngo-esophageal diverticulum. Seven-hour motility studies revealed a 90 per cent duodenal and gastric retention.

Laboratory Studies. Urinalysis on admission showed albumin and a few casts. The patient continued to have albumin and casts in her urine until shortly before discharge at which time urinalyses were essentially negative. Examination of the blood showed 5,200,000 red cells, 9,000 white cells, and 111 per cent hemoglobin (due to dehydration), whereas just before discharge there were 5,040,000 red cells,

11,050 white cells and 81 per cent hemoglobin. Examination of the stools gave essentially negative findings. Blood sugar estimation one-half hour postprandial was 143 mg. per 100 c.c., blood chlorides 478 mg. per 100 c.c., and the carbon dioxide combining power was 62 per cent. Large amounts of saline were given pre-operatively, so that following operation the level for blood chlorides was 561 mg. and the carbon dioxide combining power was 54 per cent. The urea clearance was 45 per cent the first hour and 44 per cent the second hour with a blood urea of 27 mg. Following operation, the blood urea rose to 42, but gradually returned to 30 mg. per 100 c.c.

The patient was admitted to the hospital for exploratory laparotomy. She was placed upon a pre-operative routine which consisted of liquids, hard candy, intravenous glucose, infusions of saline solution, purgatives of magnesium sulphate, enemata, and gastric lavages. The last three days before operation, a nasal tube was passed, left in situ, connected with a Wagensteen apparatus, and continuous gastric lavage was kept up by permitting the patient to drink water at will.

resected and the ends of the duodenum and jejunum were closed over respectively. (Fig. 3.) This was followed by a side to side duodeno-jejunal anastomosis. (Fig. 4.)

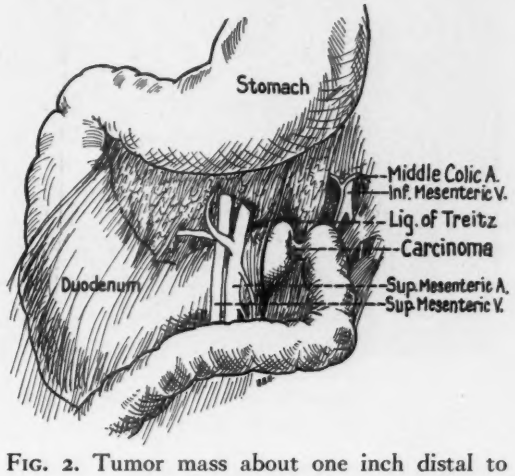

Fig. 2. Tumor mass about one inch distal to ligament of Treitz.

Pathologic Examination. The specimen consisted of a segment of small intestine including the duodenojejunal junction at the site of Treitz's ligament. (Fig. 5.) It was 7 cm. in

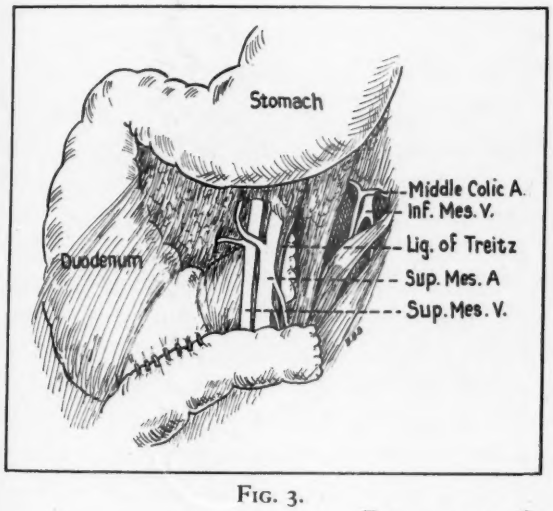

Fig. 3.

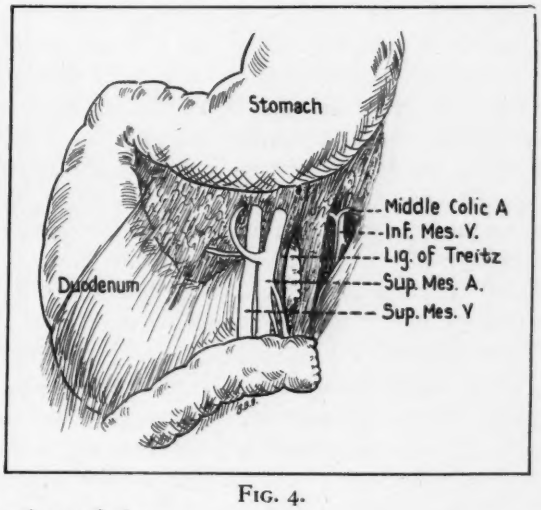

Fig. 4.

Figs. 3 and 4. Operative technique.

Laparotomy was performed and a stenosing tumorous mass was found approximately one inch distal to the ligament of Treitz. (Fig. 2.) It was about the size of half an English walnut and was freely movable. There were no visible or palpably involved nodes in the neighborhood of the mass. The duodenum proximal to the obstruction was markedly dilated. Seven centimeters of the duodenal-jejunal junction were

length and included a moderate amount of mesenteric fat. At the center of the segment there was a narrow circular constriction, causing marked indentation of the outer coats and a pronounced reduction of the lumen which scarcely admitted a lead pencil. On opening the intestine, a roughly circular tumor mass measuring 2.5 cm. longitudinally and 2.5 cm. transversely was found on the mesenteric border

It involved about two-thirds of the circumference of the intestine. The gross appearance was that of an adenocarcinoma. Microscopic examination (Fig. 6) revealed a section of the jejunal wall covered on one end by practically normal mucosa and on the opposite end an adenocarcinomatous growth originating in the mucosa, infiltrating all of the coats, and extending directly into the mesenteric fat.

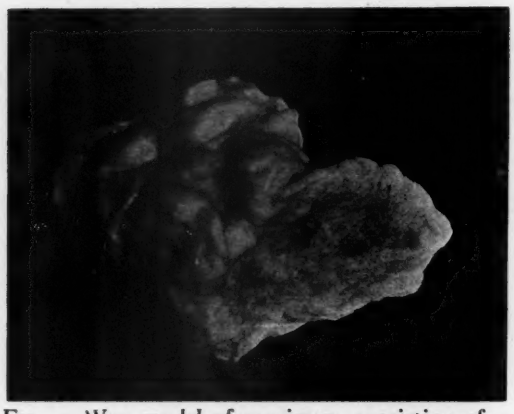

Fig. 5. Wax model of specimen, consisting of a segment of small intestine including duodenojejunal junction at site of Treitz's ligament.

The patient stood the operative procedure satisfactorily, and following the operation she was given a transfusion of 500 c.c. of whole blood, while the continuous intravenous administration of 5 per cent glucose in saline solution was started. On the third post-operative day, the nasal tube was removed and fluids were given by mouth. Although she took fluids satisfactorily, she was nauseated and vomited frequently due to regurgitation from the esophageal diverticulum. On the fourth post-operative day, the continuous intravenous infusion of fluids was discontinued. The following day, an attack of vomiting resulted in rupture of the abdominal wound. Following repair of this, she had a very smooth convalescence and was discharged twenty-three days after operation at which time she had no complaints and was able to eat anything without the slightest discomfort.

The patient has been seen once a month since operation and the last time she was seen she weighed 163 pounds, a gain of 18 pounds. The appetite was good and it has been necessary to resort to laxatives only occasionally. She had no complaints whatsoever and her condition was considered as excellent, except for a little trouble due to the diverticulum of the esophagus, which will be excised after sufficient time has elapsed to be fairly certain that recurrence has not taken place.

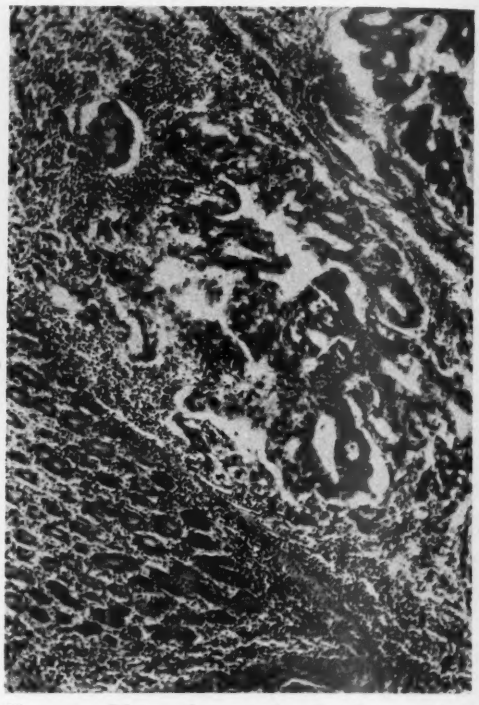

Fig. 6. Photomicrograph showing adenocarcinoma of jejunal wall. (× 150.)

SUMMARY

The difficulty of early diagnosis of carcinoma of the jejunum is reflected in the curability rate. Even early Roentgen therapy is of little value because a considerable degree of obstruction must be present before it is manifest and, frequently by this time, some extension has taken place. Routine examination of the stool for occult blood and insistence on early exploratory operation in the absence of definite Roentgen findings seem to offer the only hope of detecting these cases earlier so that the curability may be increased.

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BONE GROWTH FOLLOWING AMPUTATION IN CHILDHOOD*

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IN the spring of 1935 we assumed the orthopedic service at a Home for Crippled Children. Among the many cases there, we found eight amputation cases, six involving the leg, one involving both humeri, and the other a disarticulation through a knee.

These eight cases illustrated a phenomenon that we had never previously met, i.e., natural growth of bone from the remaining superior epiphysis of all the cases except the knee, and here both epiphyses were functioning. This normal growth had created difficulties with the stumps. These cases were discussed with a number of surgeons whose experience had extended over a long period; they had never met this problem. Following these discussions, a large number of textbooks, both old and modern, were consulted, particularly in regard to the leg amputations, and nowhere was the problem of post-amputative bone growth considered. We found in the text a variation as to flap formation, but all were in accord as to the treatment of the bones themselves. The fibula must always be sectioned at a higher level than the tibia. With this preponderance of written opinion we must accept the higher section of the fibula as a standard procedure.

A review of the literature was equally sterile. Apparently this condition has been observed and never considered worthy of mention, or else no one has previously observed the condition. These would seem to be the only explanations for the lack of literary reference. In either event, this series of cases appeared to us to be of sufficient importance to be reported.

This report is based upon six males between the ages of 10 and 14 who had previously lost a portion of the leg, in varying positions from the junction of the lower and middle thirds to the junction of the middle and upper thirds. In all of them there were "pencil" stumps and in all of them the fibula had outgrown the tibia 2 to 4 inches. This in itself was a peculiarity, as we have been led to believe that the superior tibial epiphysis was one of the most active, if not the most active, epiphysis in the body. If this supposition was correct the natural corollary would be that in the case of amputation affecting both bones of the leg the tibia would outgrow the fibula, instead of the reverse condition.

The supposition is that the standard procedure was followed, i.e., the fibula was cut at a higher level than the tibia. These cases have come to us from various regions, and it is hardly likely that any of the operators cut the tibia shorter than the fibula. In fact, most of these patients had worn artificial legs before admission, but could no longer wear them when seen.

The question arose as to why this overgrowth had occurred. One could not blame prosthesis pressure as a stimulating factor, as this pressure would have affected the tibial tuberosities to a much greater degree than the fibular head. It is doubtful that the original trauma affected the growth, since had this been true, the tibia should have been as much involved as the fibula. Certainly end pressure from a prosthesis is

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not an answer, as in normal amputation the tibia will bear the majority of end weight. In these cases it was impossible to wear a prosthesis after the fibular growth had exceeded the tibia.

It would seem evident from this series that sufficient attention has not been paid to the superior fibular epiphysis as a factor in normal growth, but that most of the attention has been directed toward the larger and apparently more active superior tibial epiphysis. Must our preconceived ideas be revised?

In treating the four longer stumps, we made a lateral incision over the fibula, exposed it and cut it 2 inches shorter than the tibia; in two of these cases, it was also necessary to redress the lower end of the tibia which had become sharpened. In the two shorter cases lateral incisions were made and the entire fibula removed. In the first one of these no drainage was used in the space where the tibia had been and considerable swelling resulted, making it necessary to remove two sutures for drainage purposes; there was no infection but full healing did not occur for one month. In the second case, done some time later, drainage was placed and no postoperative swelling occurred; there was healing within two weeks. All of these patients have been able to wear artificial limbs with comfort since operation and all but one have been discharged to their homes (that one had no home).

One patient with disarticulation of the right knee pointed a moral in such cases during the growing period. He was twelve years of age, and had been operated on three years before we saw him, as a result of vehicular trauma. For two years he had been comfortable, but in the third year the lower end of the stump began to ulcerate. At first the ulcers would heal after the artificial limb had been removed, but later they failed to heal even in the absence of end pressure. Finally, the remaining articular cartilage was exposed, and the skin over the entire end of the stump was tight and atrophic.

This problem was met by a Gritti-Stokes procedure, even though we realized that we were removing an important epiphysis. The patella failed to unite to the lower end of the femur and slipped back to its anterior position. The patient had voluntary control of the patella and would move it at will with a great deal of satisfaction. An artificial prothesis was fitted with entire comfort. Two years have elapsed and, from reports from the boy, he is perfectly happy and as active as one could desire. There has been no further discomfort with his stump. This brings up a point regarding the Gritti-Stokes amputation: is fixation of the patella over the femoral end an absolute necessity?

The high humeral amputation showed abundant soft tissue stump, but large spicules had grown from the bone and had penetrated the skin of the flap leaving the tips of the spicules exposed with resulting sinus formation. Here the procedure was simple. The spicules were removed at the level of the bone stump, the case requiring no further care. We have had no reports from this boy, but we believe that there has been no further discomfort. In the treatment of an acute case involving both bones of the leg immediately after accident in a child, based upon the observations reported, we would not hesitate, in the presence of a short leg stump, then and there to remove the fibula in its entirety. It is simply and quickly done, and no attention need be paid to the peroneal nerve as its functional control is no longer necessary. The procedure is practically without shock. As drainage must be used in stumps, the problem of draining the site of fibular excision would not have to be handled as a separate and distinct factor. In longer stumps it would seem quite wise to cut the fibula at least 2 inches shorter (more would be better), a long, soft-tissue flap being provided to take care of bone growth later. The condition is utterly different from that in the adult, where bone growth has ceased. Not only should the long soft tissue

flap be left in two-boned sites, but also where there is a single bone, for growth is bound to occur, and as it continues trouble will follow as in the case reported. We have pondered over the problem of the single bone or disarticulation and we have reached the conclusion that should such a case present itself, rather than to disarticulate, we would amputate above the lower epiphysis with an abundant soft tissue flap.

SUMMARY

Six cases of amputation in childhood through both bones of the leg are reported, with apparently unexplainable fibular overgrowth. The treatment has been outlined and a suggestion made as to the immediate procedure at primary amputation. A case of femoral growth and resulting stump difficulties has been discussed and a primary procedure for prevention of this difficulty has been offered.

THERE is an old medical proverb which was frequently repeated by Dr. Osler. . . . "It is much more important to know what sort of patient has a disease than what sort of disease a patient has." (Walsh)

SARCOMATOUS DEGENERATION ON A VARICOSE ULCER*

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WE report an exceptionally rare case of sarcomatous degeneration on a varicose ulcer of the leg. A thorough search of the literature has revealed only two instances of this pathology; one case, a fibrosarcoma, was similar to ours, while the other proved to be a round-cell sarcoma. It would therefore appear that our case is the second on record of a fibrosarcoma implanted on a varicose ulcer. Although it is not uncommon to find carcinomatous degeneration associated with irritation (we have seen two such cases), sarcomatous changes in the skin are a rarity.

FIG. 1. Varicose ulcer with fungating hemorrhagic growth; appearance before amputation.

In 1884 Prewitt reported his case of fibrosarcoma which was implanted upon a varicose ulcer of many years' duration. The gross appearance was that of a fungating growth. There was metastasis to the inguinal glands, and many tortuous varicose veins were present. The biopsy report was to the effect that "tumor is firm and elastic. Cut surface shows bands of firm white fibrous tissue in a semi-translucent mass. This latter exudes a serous mucous or fluid, yet is firm; not at all soft. This translucent portion is changed, in appearance, to white fibrous tissue by the action of alcohol. The microscopic appearance is to a certain degree heterogeneous. Section from the surface is composed of granulation and cicatricial tissue. On the edge of this section is a group of cells resembling the cells of alveolar or net-celled sarcoma—fibrosarcoma."

Donati's case also had varicosities with ulceration of long standing, covered with a cauliflower-like growth. After biopsy the diagnosis of round-cell sarcoma was made. This was of further interest because the patient had a simultaneous carcinoma of the left breast.

The subsequent course of the degeneration in the above two cases was not reported.

CASE REPORT

E. M., age 69 years, a leather worker, was admitted to the hospital May 26, 1937 because of an ulcer of the left leg of many years' duration.

His family history was irrelevant. He had had an occasional cough, but no serious illness or operation.

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The upper end of the ulcer was fungating (about two months?) and had hemorrhaged slightly. The only history of irritation was the use of silver nitrate applications.

X-ray examination showed no pulmonary infiltration or consolidation. The heart was enlarged and the aorta prominent. *X*-ray of the left leg disclosed periosteal thickening with

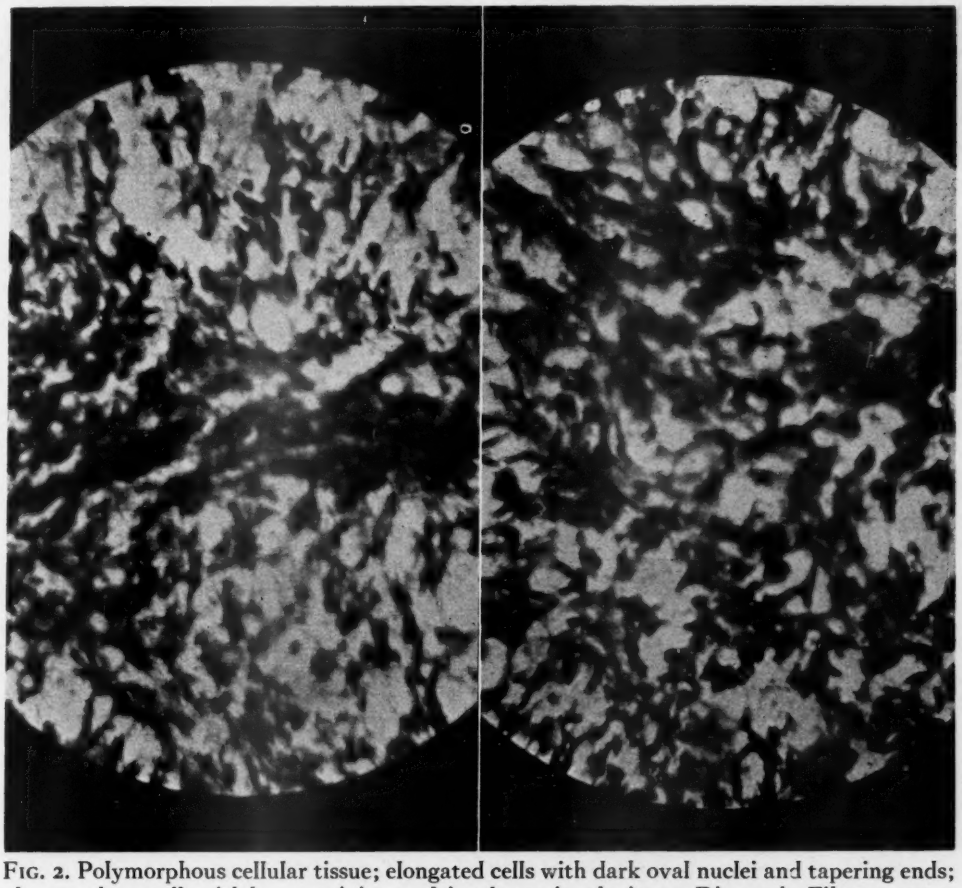

Fig. 2. Polymorphous cellular tissue; elongated cells with dark oval nuclei and tapering ends; pleomorphous cells with hyperstaining nuclei and occasional mitoses. Diagnosis: Fibrosarcoma.

The patient was not acutely ill. Head, face, nose, mouth and ears were grossly normal. The pupils were small and reacted well to light and accommodation. The neck was normal, the chest clear, the heart slightly enlarged, with regular sinus rhythm and no murmurs. Blood pressure was 135/90. Abdominal organs were palpable. The genitalia were externally normal.

The left leg had a circular atrophic ulcer, showing little tendency to heal, located on the anterior aspect and extending to the mesial and lateral sides at mid-level; the upper end of the ulcer was fungating and hemorrhagic. Trophic discolorations were present on the right leg, but no ulceration. Palpable dorsalis pedis pulsation was noted in both extremities, more definitely on the right. Moderate varicosities were present in both legs.

The diagnosis was varicose ulcer of the left leg.

cortical irregularity of the posterior margin of the fibula. No other gross bone changes of the left leg were observed.

Wassermann reaction was negative. The urine and blood chemistry were normal.

Two days later, on top of an old, nearly circular ulcer of the left leg there appeared a large ulcerated surface about 2½ inches in diameter, showing exuberant glassy granulations overlying a base of partly necrotic fibrin. There were no palpable inguinal lymph nodes. The impression was one of malignancy (epithelioma).

On June 8, a biopsy was made of the ulcer granulations. The area bled easily on traumatization and showed little or no tendency to heal. The pathologic report mentioned the hemorrhagic and ulcerated surface, and described the specimen as cellular tissue, polymorphous in type. Most of the cells were

elongated, with dark, oval nuclei and tapering ends, resembling fibroblasts. There were other cells, with vesicular, round, hyperstaining nuclei. A considerable number of blood vessels were present. There was also a considerable amount of leucocytic infiltration. The general appearance was that of granulation tissue. However, the occurrence of pleomorphous cells with hyperstaining nuclei and occasional mitoses, spoke for a more active neoplastic process. The pathologic diagnosis was fibrosarcoma.

On June 18 the patient was confined to bed. The ulcer, nearly completely circular, extended down to the bone and eventual healing seemed improbable. In the absence of demonstrable metastasis, amputation was indicated, and consultation with the cancer division confirmed this opinion.

On June 21, under spinal anesthesia, the left leg was amputated above the knee. A circular incision was made about 2 inches above the knee. The skin was allowed to retract and the muscle was cut through at a higher level. The bone was sawed through about 3 inches above the skin incision level, the periosteum and endosteum curetted, and bone wax applied to the cavity. The vessels were ligated individually. The skin was sutured with interrupted tension sutures after the soft tissues were approximated with chromic mattress sutures.

After operation, skin traction was used on the stump; clyses and heat were applied. The wound healed by primary union within two weeks.

Four months following amputation the patient was in apparent good health, and there was no evidence of metastasis.

SUMMARY

We have reported a case of sarcomatous degeneration on a varicose ulcer, which is of exceptional interest because of its rarity. It is the second fibrosarcoma associated with varicose ulcer to appear in the literature.

I wish to express my thanks to Dr. J. Rosenthal for his painstaking study of the pathologic specimens.

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PYLORIC STENOSIS FOLLOWING THE INGESTION OF TINCTURE OF IODINE

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THE corrosive effect of certain caustic fluids, when ingested either accidently or with suicidal intent, is a subject of considerable clinical importance, presenting a variety of problems influencing both recognition and treatment. The results of such a violent chemical insult to the upper alimentary passages vary from small ulcerations of the mouth and pharynx, when only a small amount of the offending substance is taken, to extensive destruction of large portions of the esophagus and stomach with prompt exitus, when a large dose is taken. The immediate treatment of such poisonings is beyond the scope of this communication. We are here concerned with one of the later sequelae in the cases which have survived the immediate escharotic effects.

Esophageal stricture is generally considered to be the ordinary result in most of such instances. Attention should be drawn to the fact, however, that a similar effect may take place in the pylorus which is of considerable clinical importance. This may occur either alone[1,2,3] or in association with esophageal stricture.[4,5]

Mechanism. Selective pyloric involvement has been attributed by Samaja[6] to a series of reflex tetanic contractions of the gastric wall which tends to concentrate the caustic fluid in the pyloric antrum. Boikan and Singer[7] point out that the presence of an air bubble in the stomach may protect the cardia and fundus at the expense of the pylorus. They also make the observation that the squamous cell epithelium of the esophagus is particularly vulnerable to alkaline escharotics such as lye, and that it is much less so to the acid caustics. This is in accord with the clinical observation that esophageal stenosis generally follows ingestion of alkalies while pyloric stenosis occurs after ingestion of acids. We have been unable to find any recorded cases of esophageal or pyloric stenosis following the swallowing of tincture of iodine other than our own case reported herewith, and we note that in its selective localization the iodine acts as an acid.

CASE REPORT

H. B., a 32 year old white man, was admitted to Bronx Hospital, June 30, 1936. Five months previously he had taken a large dose of tincture of iodine with suicidal intent. He had recovered from this episode, returned to his usual occupation, and remained well until two months before admission to the hospital when he began to experience anorexia and a sensation as if food were "stuck in his stomach." This was followed shortly thereafter by the appearance of nausea, eructations, and finally by vomiting. The vomiting usually occurred in the evening; and the vomitus generally consisted of large amounts of sour gastric contents containing partially digested food. The patient had never noticed any hematemesis, melena, or spontaneous abdominal pain. There was a loss of 6 pounds in weight during the two months preceding his admission to the hospital.

The physical examination of the patient revealed a poorly nourished individual, but there were no unusual physical findings. The urine was normal. The red blood cell count was 5,080,000; the hemoglobin was 68 per cent of the normal. The Ewald test meal revealed a total gastric acidity of 63 and a free hydrochloric acid content of 45. There was no lactic acid or blood in the stomach contents.

Gastrointestinal *x*-ray studies revealed an extremely dilated and ptosed stomach with a filling defect in the region of the antrum and duodenal cap. There was extreme delay in gastric evacuation, the forty-eight hour examination showing retention of almost the entire barium meal within the stomach. No abnormalities of the esophagus were noted. A barium enema revealed no abnormalities other

than a downward displacement of the splenic flexure by the dilated stomach. The roentgenologist felt that these findings indicated the presence of either an extrinsic or intrinsic neoplastic pyloric obstruction.

Following a period of preoperative preparation with gastric lavages and the administration of intravenous glucose infusions, the patient was operated upon. The abdominal exploration revealed an enormous dilatation of the stomach due to a tight stricture at the pylorus. There were no gross evidences of neoplasm or peptic ulcer. The remainder of the abdominal cavity and its contained organs seemed normal. A posterior, retrocolic gastrojejunostomy was performed.

The postoperative course was entirely uneventful. Vomiting stopped immediately and the patient left the hospital on the fifteenth day after operation. Since then he has gained weight and improved in every way. There have been no subsequent gastric symptoms of any kind.

Pathology. The immediate local effect of a caustic is the production of areas of necrosis with secondary ulceration of varying depth. The mucosa is usually destroyed completely and the necrotizing process extends to the submucosa and muscularis. Occasionally the serosa is also involved with resultant perforation of the viscus. The adjacent portion of the walls of the stomach becomes thickened and deformed, and the replacement fibrosis usually leads to the formation of a tight inelastic stricture at the pylorus. Occasionally this resembles grossly, a scirrhous carcinoma. At times, the lesion develops proximally to the pylorus and results in an hour-glass deformity of the stomach.[8]

Such changes necessarily result in prolonging the emptying time of the stomach. Secondary compensatory changes including gastrectasia and hypertrophy of the gastric wall ensue. In most cases complete pyloric stenosis supervenes with fatal outcome unless the mechanical obstruction is relieved by operation. In the case reported by McLanahan[9] the stenosis had become so complete that post-mortem examination of the specimen revealed a complete occlusion both anatomically and functionally.

Histologic examination reveals extensive connective tissue replacement with evidences of active gastritis as late as six months after the ingestion of the caustic. In most cases, however, gastric mucosa regenerates although there appears to be a subsequent reduction in its ability to secrete hydrochloric acid. In Putnam's[10] case there had apparently been a complete destruction of the gastric mucosa which, during the reparative stage, had been replaced by squamous epithelium growing downwards from the esophagus.

Clinical Picture. Following recovery from the initial effects of the poison, the patient generally makes a rapid recovery and is often discharged from the hospital in almost normal state. Symptoms of pyloric stenosis generally begin to make their appearance about four weeks later, although latent periods of five[11] and six[12] years have been recorded in the literature. Nausea becomes a prominent symptom and is soon followed by occasional vomiting which quickly becomes repeated with greater and greater frequency. Then the general signs of inanition and dehydration appear and unless the condition is relieved death eventually results.

Roentgen examination usually reveals a marked pyloric stenosis, at times of an irregular configuration very similar to the roentgenographic appearance of an obstructing pyloric carcinoma.

The diagnosis can usually be made on the basis of the history, but even this may not be sufficient to exclude the presence of an independent pyloric neoplasm.

Treatment. The therapeutic management of this type of pyloric stenosis must be surgical. The various procedures which have been advised can generally be classified into four groups.

1. Manual dilatation of the pylorus through a gastrotomy was suggested by Loreta[13] and by White and Lane;[14] but the method is very unsatisfactory and has been given up entirely.

2. Pylorectomy was performed by Czerny[15] and Monprofit[16] after unsuccessful attempts at manual dilatation of the pylorus. This method was also used by von Eiselsberg.[17] At present, however, it is felt that so radical a procedure is unwarranted unless it is impossible to differentiate the cicatricial mass from a malignancy during the course of a laporotomy, as happened in Putnam's case. Furthermore, as Schmieden[18] points out, the inflammatory changes in the gastric wall may cause considerable difficulty in the extensive suturing necessarily incident to this operation.

3. Pyloroplasty according to the Heinecke-Mikulicz[19] technique has been used with varying success by a number of operators, including Mikulicz,[20] Colzi,[21] Postempski[22] and others; but in this procedure, as in pylorectomy, the technique is unnecessarily complicated and the suture line precarious due to the damaged state of the involved tissues. This operation has not been practiced in recent times.

4. Gastrojejunostomy seems to be the most rational method of overcoming the pyloric stenosis. In competent hands it is attended by the lowest mortality; its performance does not require incision into scar tissue; and, when properly made, the new stoma permits a return to as normal a gastric physiology as is possible. According to Koellner[23] the first gastrojejunostomy for pyloric stenosis due to poisoning was performed by Monastyrski[24] in 1884. One year later Sklifossowski[25] also attempted this procedure. Both of their patients died. Quénu[26] and subsequent surgeons, both American and foreign, have been more fortunate, so that gastrojejunostomy is now recognized as the operation of choice for this as well as other forms of cicatricial pyloric stenosis.

It is, of course, highly advisable to prepare this type of patient for operation as well as his condition will permit. Boikan and Singer[7] recommend that an attempt be made to postpone operative treatment until six months after the original poisoning if this is feasible, the maintenance of the patient's nutrition being meanwhile accomplished by a high caloric liquid diet. This is done in order to allow the original gastritis to subside as much as possible. While this is a reasonable suggestion, we feel that one should not be bound by any arbitrary time limit and that care must be taken not to allow the general condition of the patient to become so debilitated by any prolonged period of semi-starvation as to endanger recovery from the necessary operative interference. Once the initial violent inflammatory changes have subsided it seems better to operate while the general nutrition is still good even though the gastritis has not completely subsided than to wait until there is complete anatomic restitution to the normal at the cost of marked impairment of the general nutrition. Such considerations relating to the optimum time for operation must vary with the individual case and call for accurate judgment on the part of the surgeon.

Parenteral fluids and transfusions of blood form an essential part of the pre- and postoperative treatment and are to be administered according to well established indications. Preoperative gastric lavages are likewise of value, not only in diminishing the degree of gastric stasis, but in improving the tone of the dilated stomach.

Occasionally the condition of the patient is so poor that an attempt at gastrojejunostomy would be unduly hazardous. Rieder[27] has suggested a preliminary jejunostomy for feeding purposes in such cases to be followed at a later date by gastrojejunostomy. This procedure has also been followed by Kanno and Seian[28] and by Bruce.[29] These observers report complete satisfaction with it in selected cases.

SUMMARY

1. Attention is directed to a fairly common syndrome of pyloric stenosis following ingestion of corrosive liquids.

2. A case in which tincture of iodine produced this lesion is recorded.

3. Gastrojejunostomy preceded, if necessary, by jejunostomy, is recommended as the procedure of choice in the surgical correction of the condition.

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NEW TECHNIQUE IN TREATMENT OF DUODENAL FISTULA

REPORT OF CASE

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THIS case is reported because it demonstrates a new use for the capillary drain reported by Thompson and Wright,[1] and also because with this technique the time required for closing of the fistula is much more rapid than with other techniques reported in the literature.

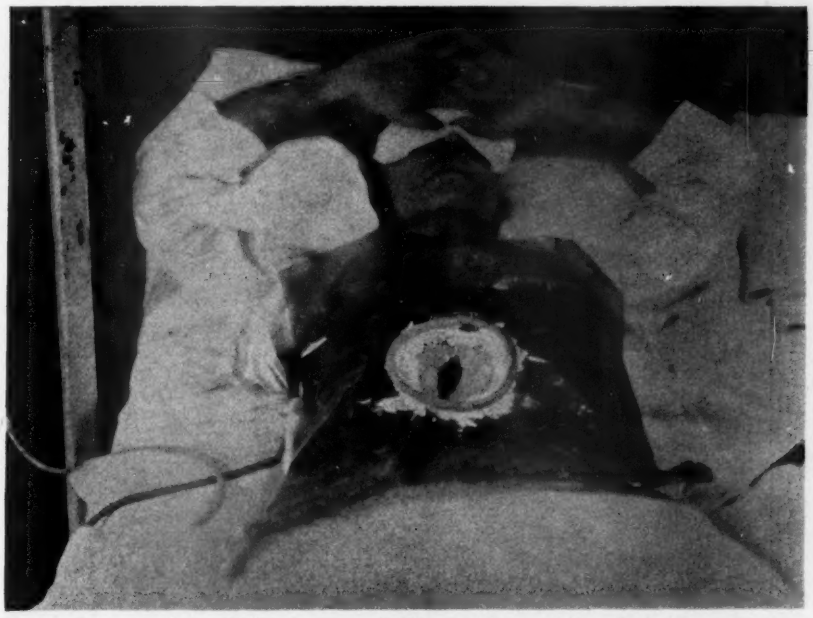

FIG. 1. Note catheter lying in wound. Zinc oxide on skin, oiled silk next, then rubber ring. Wound at time of closure of fistula.

The general consideration of duodenal fistula has been well presented in papers by Potter,[2] Kittelson,[3] and others. This paper, therefore, mentions only the work which used principles embodied in the technique herein described.

Erdman[4] in 1921 advocated jejunostomy, suction, and large amounts of water by mouth. Potter advocated irrigation of the fistula with $\frac{1}{10}$ normal hydrochloric acid, 20 to 60 drops per minute, and the use of the duodenal tube by mouth. In his papers he does not mention how the effluent solution is handled. In the case herewith detailed, neutralization was replaced by dilution, and suction was used, employing the capillary drain. It is not my purpose to criticize neutralization as a principle. In this case it was not needed.

CASE REPORT

A male, age 54, on June 10, 1937, arose at 3:00 A.M. After taking a drink of water, he was stricken with a sudden pain, so severe that he fell to the floor and was unable to return to bed. Medical attention was quickly obtained and a diagnosis of gallstone colic was made. Large amounts of pain-relieving medicine were used, but the pain lasted for about four days, following which the patient suffered from nausea and complete loss of appetite. At the end of three weeks, he was still suffering, and at this time a gall-bladder *x*-ray revealed a gall-bladder which filled and emptied, with no stones visual-

ized. The patient was referred to the writer at this time.

He had had nausea and epigastric pains at intervals for three years, for which he used Sippy powders. The temperature was 101°F. There were epigastric splinting and tenderness. An intravenous pyelogram was negative. *X*-ray examination of the stomach revealed that the lesser curvature was fixed. Peristaltic waves were visible only on the greater curvature. Four successive pictures showed the lesser curvature constant in outline and the greater curvature variable. The leucocyte count was 19,000, with 94 per cent polymorphonuclears. On the basis of these findings a diagnosis was made of ruptured duodenal ulcer with residual abscess at the lesser curvature of the stomach.

Fig. 2. Flat gauze over wound to filter out solids in wound secretions. End of capillary drain placed on gauze.

Fig. 3. Gauze turned in to be entirely within the rubber ring. Zinc oxide ointment spread around ring.

At operation on July 2, the abscess containing about 4 ounces of pus, was found. The gall-

bladder was surrounded by adhesions, but was otherwise normal. In the vicinity of the duodenum there was a granulating area, but no perforation was visible. Drains were placed and the wound closed.

Twelve hours after operation the dressings were found to be saturated with clear fluid, later followed by fluid with a yellowish sediment. Digestion of the wound was not very extensive until July 6, at which time the wound was dressed with powdered milk. On July 8, the wound was not improved and the dressing method was changed. The capillary drain, as described by Thompson and Wright[1] was used. In twenty-four hours, 1,025 c.c. of drainage was collected. This of course did not include fluid saturating the dressing.

Fig. 4. A second, smaller sheet of oiled silk covers other parts of dressing. Zinc oxide covers capillary drain where it leaves the oiled silk.

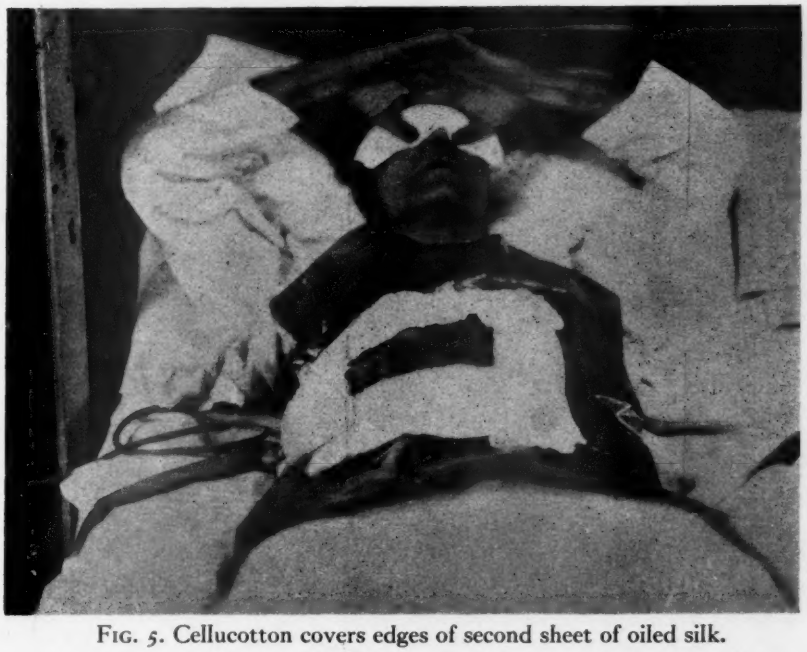

Fig. 5. Cellucotton covers edges of second sheet of oiled silk.

The capillary drainage had no visible effect on the wound. On July 10, the wound was continuously flushed with normal salt solution

using 120 drops or more to the minute (over 10 liters in twenty-four hours). Following this the wound rapidly improved in appearance and crater rapidly healed, leaving a narrow sinus which discharged a small amount of pus for six weeks more, then healed completely.

FIG. 6. First sheet of oiled silk is folded over the dressing. Large sheet of cellucotton placed over entire dressing.

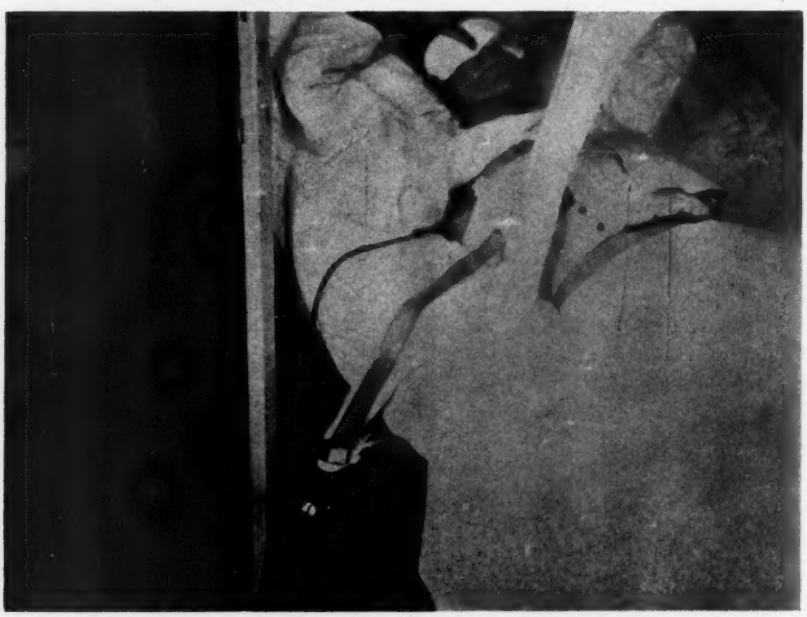

FIG. 7. Many tailed binder placed over dressing. Murphy drip container provides a flow of 120 drops or more to the minute.

four days later the duodenal drainage stopped completely. At this time the wound was rapidly granulating. Urinary output tripled when the fistula closed. A purulent discharge continued for another week until a mass of brownish material, interpreted as inspissated duodenal content, was forced out of the wound. The

DETAILS OF DRESSING

Details of the dressing are illustrated in Figures 1 to 7.

The capillary drain is made by using a Penrose drain rubber tube one yard long. A square yard of gauze is rolled into a uni-

form cylindrical roll and drawn through the Penrose rubber tube. The gauze extends 3 or 4 inches beyond the rubber tube at the end which is placed on the wound. In the upper angle of the wound is placed a small rubber tube which carries the Murphy drip solution, and around the wound there is a ring of zinc oxide ointment. A square of oiled silk with a circle cut out at the center is pressed down on the zinc oxide ring, making complete contact all around the wound. On top of the oiled silk we place a ring of rubber tube with the ends held together by a safety pin (the safety pin part of the ring is placed above). Zinc oxide ointment is then packed around the rubber tube and a flat gauze dressing inserted over the wound inside the circle of rubber tube.

A capillary drain, described above, is thoroughly soaked in sterile water and is then fixed with one end on the flat gauze and the other end in the bottle at the side of the bed. Another sheet of oiled silk, smaller in size than the first, covers the dressing and is pressed carefully into the zinc oxide. Around the margins of this square of oiled silk are strips of cellucotton, with the edges of the first piece of oiled silk folded over them. A large pad with lacings to hold it in place and the usual binder, completes the dressing.

This rather elaborate dressing allowed constant irrigation of the wound with a fairly fast flow of normal salt solution without causing the patient to suffer from the seepage of more than a small amount of fluid from the dressing. Very often the patient remained completely dry, except for the dressing, for hours at a time.

CONCLUSION

The capillary drain makes it possible to use extreme dilution in the treatment of duodenal fistula.

Doubtless other conditions will be found which will be benefited by use of these principles.

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PLASMA CELL MASTITIS: A PATHOLOGIC ENTITY*

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OF all those inflammatory states to which the breast falls heir, plasma cell mastitis most frequently and consistently masquerades as cancer. The term "plasma cell mastitis" is given to a subacute or chronic inflammation of the breast characterized by a rich plasma cell exudate. It was first noted and described by Ewing and his observations correlated with a clinical entity established by Adair in a study of ten cases. Undoubtedly, it has chagrined the surgeon and confounded the pathologist in the past. The former has generally considered it carcinoma and the latter, although he has observed and probably recorded the unusual plasma cell infiltration, has grouped the process under the non-specific inflammatory states of the breast.

Cutler has reviewed the older literature and failed to find any reference to acute or subacute inflammatory states of the non-lactating breast with the exception of those noted in complicating infections such as typhoid fever or parotitis. Clinically, the features of plasma cell mastitis appear to have been noted by Courtin in 1899. He observed a breast lesion with skin fixation, nipple retraction and axillary adenopathy accompanying a mass in the breast of a 50 year old female. After four weeks of local applications, the mass disappeared. Coquet, discussing this case, reported a similar case. Neither report was accompanied by histologic studies. It remained for Adair in 1933 clearly to present this inflammation of the breast as a clinical entity. Since then the surgeon has been stimulated to differentiate this process, and both Cutler and Moore have reported cases. Others have undoubtedly been observed but not recorded. As yet the pathologic aspects have not received much attention in the literature of pathology.

ETIOLOGY

Although large cocci growing in pairs or short chains were isolated in four of Adair's cases, infection was thought to play a less prominent rôle in the etiology than that played by chemical irritation from stagnating breast secretions, the converse of suppurative mastitis. Two cases showed gross pathology, and a third presented a histology suggesting tuberculosis, but guinea pig inoculations were negative.

The average time since last lactation was four years, but this seemed to have no bearing on etiology. On the other hand, in no case did plasma cell mastitis occur in an unmarried woman. There was an average of four pregnancies in each patient. Adair believes that this is strong support of improper breast drainage as a cause of the process.

In Adair's ten cases the age range was from 29 to 44 years, with an average of 36.3 years. Cutler's patient was 50 years of age.

GROSS PATHOLOGY

In Adair's ten cases, nipple retraction occurred in 80 per cent, skin adherence in 60 per cent, enlarged axillary nodes in 80 per cent, peau d'orange appearance in 40 per cent, and in 70 per cent creamy purulent material could be expressed from the nipple.

The mass in the breast is usually either very firm or hard. It varies from a sharply defined area to an ill defined but localized mass. The lesions have averaged 4 to 5 cm.

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in diameter, the largest being 8 × 8 × 10 cm. In one case the axillary mass was 4 cm. in diameter.

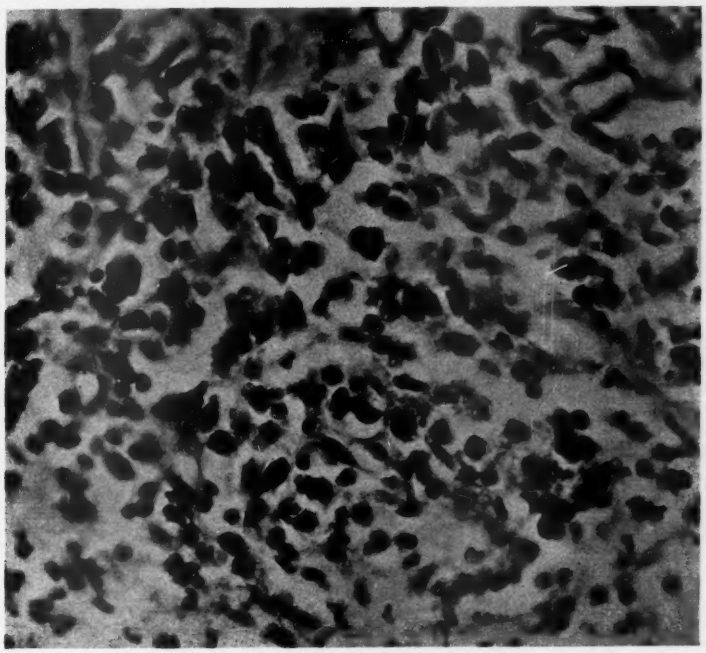

Fig. 1. Plasma cell mastitis. A high power field showing the plasma cell infiltration and the giant cell formation.

On cut section, the breast will show numerous dilated tortuous ducts and small cysts containing thick grayish creamy material. This duct process is often diffuse. The tumor area presents radiating strands of dense translucent fibers, often with a pinkish inflammatory appearance. Small necrotic foci may be seen. The main mass is often very dense and almost cartilaginous. In one case Ewing observed chalky streaks in the radiating fibrous tissue, but this is rare and seldom causes confusion with cancer. Often the cicatricial tissue is grossly suspicious of malignancy and by palpation alone it may be impossible to distinguish it from carcinoma. Peculiar ochre yellow points and xanthomatoid foci 1 to 3 mm. in diameter have been seen. These are not purulent or semifluid, yet are not firm enough for tumor tissue. The mass may be found at the apex of a radiating group of dilated ducts. The diffuseness of the mass, absence of a discrete tumor, creamy discharge from the ducts, frequent lack of cicatrization or chalky streaks, and dilated ducts are all compatible with an inflammatory process.

HISTOPATHOLOGY

Microscopically, the most striking feature is the inflammatory exudate which is preponderantly plasma cell in type. With this is, however, often a distinct polymorphonuclear neutrophile infiltration and some lymphocytes, but the unusual number of plasma cells is impressive. The reaction involves both the glandular and the interstitial elements, but is especially prominent around the ducts where it consists of almost pure plasma cells. The large ducts are distended with purulent cellular débris, while the smaller ducts in addition, present lumens partially obliterated by a desquamative epithelial hyperplasia. The picture often resembles, in this hyperplasia, comedocarcinoma for which it has been mistaken. The walls of the larger ducts are seen to be infiltrated with plasma cells, even to the extent of obliteration of the normal duct architecture.

Where small xanthamatoid foci are seen, they are very cellular, being composed of

large round to polyhedral cells with lipoid material distending them. These foci may be attended by polymorphonuclear cells for such, a paraffin section shows the process to be confined within the walls of the ducts and acini. On frozen section, the

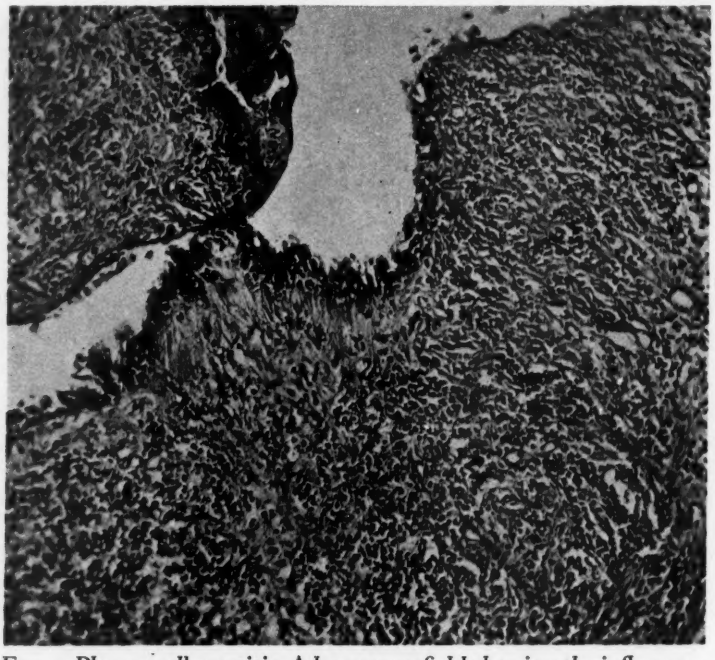

Fig. 2. Plasma cell mastitis. A low power field showing the inflammatory reaction about a duct.

and form miliary abscesses. All foci contain plasma cells which, in addition, infiltrate the stroma in sheets, cords and avoid masses. It may be so extensive as to blot out the glandular configuration of the tissue.

Diffuse growth of young connective tissue often accompanies the process and dense reactive fibrosis occurs. This extends out into the more normal breast and supportive tissue, accounting for the adhesive and retractive gross features suggesting cancer. Intermingling with the cellular reaction are frequently seen giant cells which may form conspicuous sheets infiltrating the stroma along with the plasma cells. These giant cells of foreign body type are often encountered where there is marked epithelial hyperplasia. In one case, the configuration of the giant cells and the fibrous reaction resembled miliary tubercles.

Although the epithelial hyperplasia may undergo such changes as to resemble cancer, and on frozen section be mistaken disorderly and atypical epithelium appears at times to have invaded the surrounding tissue. Again, the large edematous plasma cells and giant cells, poorly fixed on frozen section, may resemble small infiltrating carcinoma cells.

DIFFERENTIATION

Except as noted above, it is uncommon to confuse plasma cell mastitis histologically with malignancy. In the presence of extensive desquamative epithelial hyperplasia with comedo formation, the presence of malignant cells beyond the confines of the duct and acinar walls must be excluded.

Usually the preponderance of plasma cells in the inflammatory exudate serves to distinguish this entity from such confusing processes as chronic lactation mastitis, traumatic fat necrosis of the breast, tuberculous mastitis, syphilitic mastitis and various forms of non-specific subacute and chronic inflammatory masses.

The abscess and draining sinus will in many cases rule out plasma cell mastitis

and suggest lactation mastitis grossly. Moreover, foci of lactation hypertrophy varying from fully developed acinar hypertrophy to small residual areas will differentiate lactation mastitis.

In traumatic fat necrosis, there is often a definite area of liquefaction and necrosis. Microscopically, there are many giant cells, often in sheets similar to those observed in plasma cell mastitis, but here the giant cells show ingested fat droplets and lipoid crystals. Amidst new fibrous tissue and surrounded by giant cells are seen "cigar-shaped" areas of cholesterol and groups of broken down fat cells. Large epithelial cells accompany the fat necrosis and may be mistaken for plasma cells which must also be differentiated from the numerous attendant phagocytic mononuclear cells.

One of Adair's cases was grossly considered tuberculosis in that it showed a wide area of skin infiltration, discoloration and irregularity suggesting an old healed sinus. Another case appeared tuberculous on cut section of the tumor. A third case, histologically, presented a cellular reaction with giant cells similar to the tubercle. If there is a draining sinus, it rules against plasma cell mastitis. However, in the absence of suppuration, these two processes may be indistinguishable even grossly. The histology of tuberculosis needs no illumination and the plasma cell exudate is usually sufficient to solve the problem. Yet swollen plasma cells and giant cells may be easily confused with a tuberculous granulation tissue.

Syphilis of the breast is rare. Adair in 1924 found only forty-five cases in all the literature. This very rarity probably accounts for its non-recognition. Its gross manifestations are protean, often simulating cancer, especially before central necrosis and sinus formation ensue. Microscopically, lymphocytic infiltration of the media and the perivascular concentration around adventitial vessels serve to distinguish syphilis of the breast.

The diagnosis of subacute and chronic mastitis of the simple forms is facilitated by the fact that it is more commonly bilateral and more extensive. The breast can be picked up as a whole, and has a saucer-like edge. The inflammatory reaction rarely shows more than an occasional plasma cell.

To the pathologist, the clinician can often give an illuminating story in plasma cell mastitis—that the onset is acute with moderate fever and presents a diffusely tender mass in a non-lactating breast covered by a reddened, hot, edematous skin and accompanied by enlarged tender axillary nodes. The progress is characteristic; it is one of slow but continuous regression, leaving a lump in the breast that is hard but not painful and neither increases nor decreases in size with time. Inflammatory carcinoma of the breast may closely resemble this picture in the early stages. However, subdermal lymphatic invasion by the cancer results in irregular thickening of the skin which is distinctive, and the growth is steadily progressive. Diffuse duct carcinoma, also, in the presence of superimposed inflammation, may simulate plasma cell mastitis but it likewise is steadily progressive.

No better termination of this discussion could be made than to quote the words of James Ewing from Adair's original article:

"From a survey of the present material it appears that we are applying the term plasma cell mastitis to a special group of cases which belong in the general class of chronic or subacute suppurative inflammation of the duct system of the breast. These cases differ from the ordinary suppurative mastitis in the absence of definite abscesses and generally in the wide extent of the process. The process is also less acute and the productive element much more pronounced than in suppurative mastitis. These facts indicate that bacterial infection plays a less prominent rôle and chemical irritation a more prominent rôle than in suppurative mastitis. In the particular group of cases which has attracted our

attention, the plasma cell infiltration is extremely abundant and widespread, producing rather bulky tumor masses which clinically resemble active carcinoma, and even under the microscope may be difficult to distinguish from cellular carcinoma.

"The main gross anatomic feature is the presence of many much thickened ducts which are filled with puriform material, and may extend over a large segment or nearly the whole of the breast. In most characteristic cases the cellular exudate is diffuse, making a broad opaque, sometimes yellowish tumor-like mass in which distended ducts are less obvious or not even visible. These are the cases which resemble carcinoma, but as a rule, there are small foci of puriform softening which are not found in carcinoma.

"The plasma cell exudate begins in the walls of the ducts and extends between the acini in adjoining lobules where the process becomes diffuse. Polymorphonuclear leucocytes are present in variable numbers, but are often very scanty. The phagocytosis of fat is a prominent feature and many of the cases show a great many large plasma cells engorged with fat and resembling xanthoma. These areas have a yellow color.

"Proliferation of the lining epithelium is a peculiar and prominent feature. The affected ducts are lined by from six to ten rows of large, somewhat hyperchromatic, epithelial cells which often raise the suspicion of carcinoma of the duct. Yet the later progress of these proliferating cells ends not in carcinoma but in generation fragmentation and formation of giant cells of all sizes. Many of the giant cells and degenerating epithelium produce structures which closely resemble tuberculosis. Usually the foreign body nature of these giant cells is obvious because they usually contain much fat. Stains for tubercle bacilli are negative, and guinea pig inoculations are also negative. The appearance of the proliferative epithelium in the early or milder stages of some cases strongly recalls the appearance of comedocarcinoma. In a few cases the proliferating epithelial cells produce many small hyperchromatic giant cells, a picture which again approaches that of large cell carcinoma."

As such the entity remained until C. W. Cutler, in 1934, reported a case of a tumor in the left breast of a 49 year old female who subsequently developed tumors, histologically identical with the breast tumor, in the larynx, the fascia over the sternoclavicular joint, in the upper right border of the left breast and in the right antrum. The original breast tumor was called a plasma cell mastitis. The case was seen and discussed by Drs. Adair and Ewing. Dr. Adair considered it a metastasizing plasma cell mastitis. Dr. Ewing considered it a plasma cell tumor and was of the impression that plasma cell changes with tumor formation occurred chiefly in fatty areas such as the breast and bone marrow. If the original tumor was correctly diagnosed plasma cell mastitis, it is an entity capable of metastases; if this is not the case, there is a malignant neoplasm so closely resembling plasma cell mastitis in histopathology as to be markedly confusing.

CASE REPORT

C. S., a colored married female, 48 years of age, fell and struck her left breast one year prior to entry and one week before admission noted a lump there. Close questioning revealed the fact that the left breast had been hot and tender at the time of the first trauma.

The patient had had nine children and her menopause occurred two years before she entered the hospital. She was moderately obese, with pendulous breasts. Axillary nodes were palpable and there was skin fixation and nipple retraction of the breast.

A diagnosis of carcinoma was made and radical mastectomy done.

Pathology. Gross, the specimen included a left breast and pectoral muscles with axillary contents. There was nipple retraction, and grayish puriform material was expressed from the nipple. The tumor, 3 × 2 × 2 cm. in size, was just beneath the areola, fixed to the skin. It was irregular in outline and faded into the surrounding breast tissue with radiating bands of fibrous tissue. It cut with cartilaginous resistance and showed a homogeneous gray

surface. Radiating from this mass into the breast were dilated tortuous ducts filled with puriform material. No gross pathology of the axillary nodes was noted.

Very little normal breast tissue was present. The ducts and gland acini were markedly dilated and partially filled with bluish staining vacuolated albuminous secretions. Dilated ducts and acini were lined by a flattened cuboida epithelium showing no evidence of proliferation. Other acini were much smaller and lined with a low columnar epithelium which showed evidence of proliferation in some instances. Some of the glands and ducts were lined by two or three rows of epithelium, some of which showed partial desquamation.

A large part of the biopsy specimen was made up of granulation tissue, characterized by numerous fibroblasts, newly formed blood vessels, multinucleated giant cells and an almost pure culture of plasma cells. The plasma cells were fairly large and swollen and showed a characteristic granular, faintly basophilic cytoplasm with an eccentric nucleus.

Other sections differed only in a greater abundance of mature connective tissue proliferation and localized lymphocytic infiltration. Often the sheets, cords, and foci of plasma cells were concentrated around dilated and hyperplastic ducts and acini.

Grossly the breast would be difficult to distinguish from carcinoma. The traumatic history brought in the possibility of traumatic fat necrosis, but the cut section of the tumor mass did not suggest this. The histology of the tissue immediately clarified the picture and eliminated confusion.

SUMMARY

A gross and microscopic study was made of plasma cell mastitis of the breast as presented in thirteen cases, including one here reported. Clinically this condition is often confused with cancer, but the history is characteristic. Although the gross features of the tumor are often equivocating, the histology is almost pathognomonic. It is characterized by an inflammatory granulation tissue which presents a preponderance, frequently almost a pure culture, of plasma cells. However, associated with dilated ducts and a desquamative epithelial hyperplasia, it may be confused with comedocarcinoma or its fibroblastic and giant cell formation may suggest tuberculosis. A recent case of multiple plasma cell tumors following an initial plasma cell mastitis of the breast suggests that the entity may be neoplastic after all. At least it should be considered precancerous and treated as such. The rarity of the disease is more apparent than actual, for many cases go unrecognized or unrecorded.

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REPORT OF A CASE OF MIXED TUMOR OF THE TONGUE

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MIXED tumors of the tongue have been clarified by the review of the ten cases in the literature by Brunschwig,[1] who established certain criteria for such tumors, namely—epithelial elements in any arrangement, and mesothelial structures as cartilage, muscular tissue, and fibrous connective tissue. We present the evidence in the following case as in favor of another instance of such very rare tumors of the tongue.

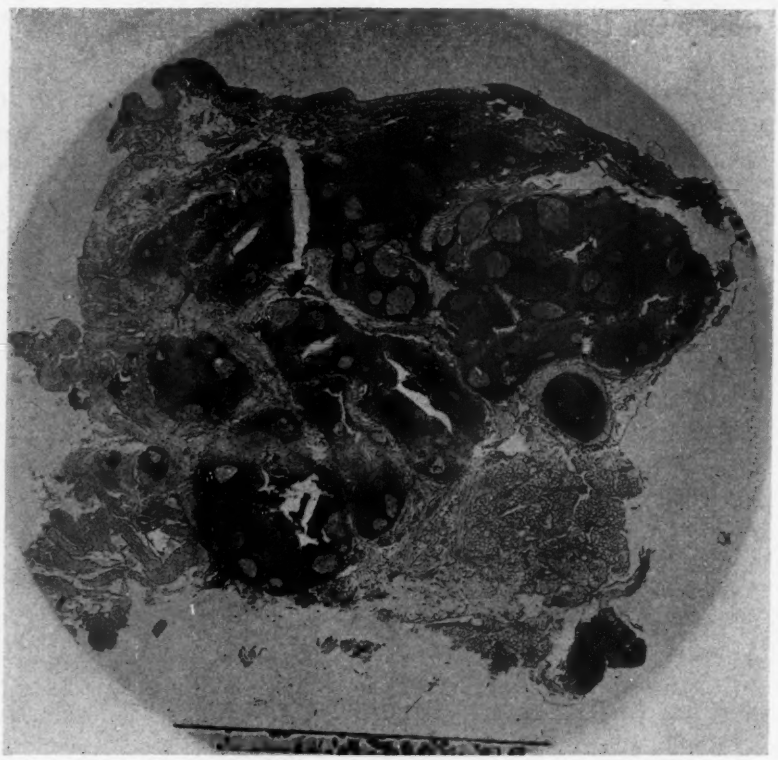

FIG. 1. Low power. Cross section of the entire tumor, showing epithelial elements (glands) in lower right corner; and, mesothelial structures (oval area of cartilage, follicles, and fibrous septa).

C. K., a dentist, was admitted to the Norwegian Hospital for removal of a small mass on the tongue which had appeared one year previously. The patient's attention was called to the development of this tumor after an inlaid filling in the left first upper molar had dropped out. He later had it removed because of the considerable irritation to the tongue produced during chewing.

The tumor, on inspection, was white, round, hard and fibrous, the size of a pea, and was located on the anterolateral aspect of the left border of the tongue, 1 inch from the tip. It was embedded in the margin, involving the entire thickness of the tongue, and it remained constant in size after its appearance.

At operation under local anesthesia, a wedge-shaped piece of tongue was removed, the incisions extending well wide of the growth.

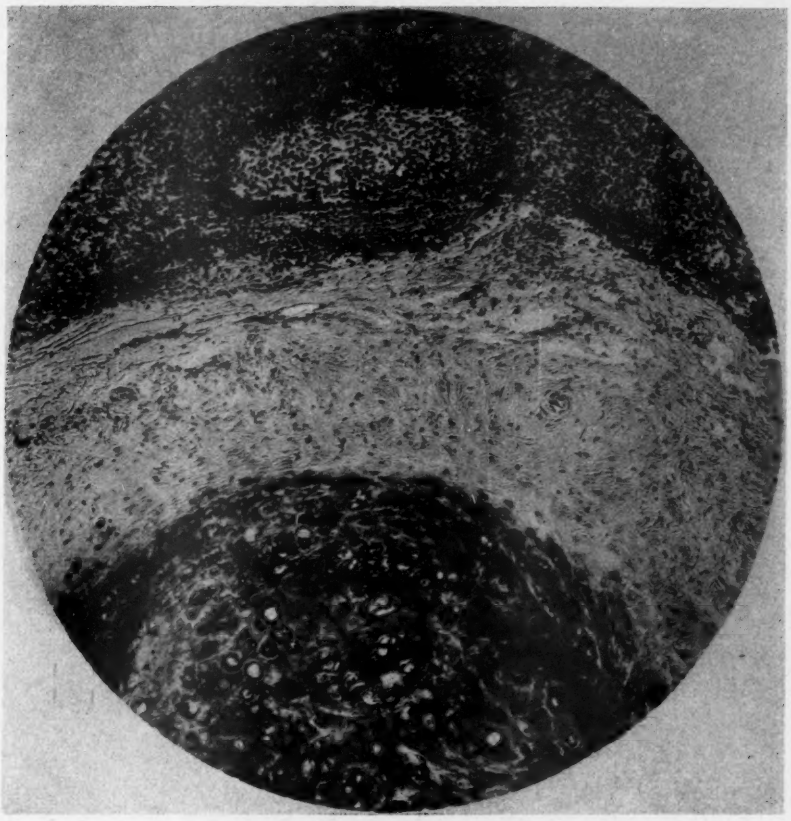

FIG. 2. Area of cartilage and lymphoid follicle with intervening fibrous septa.

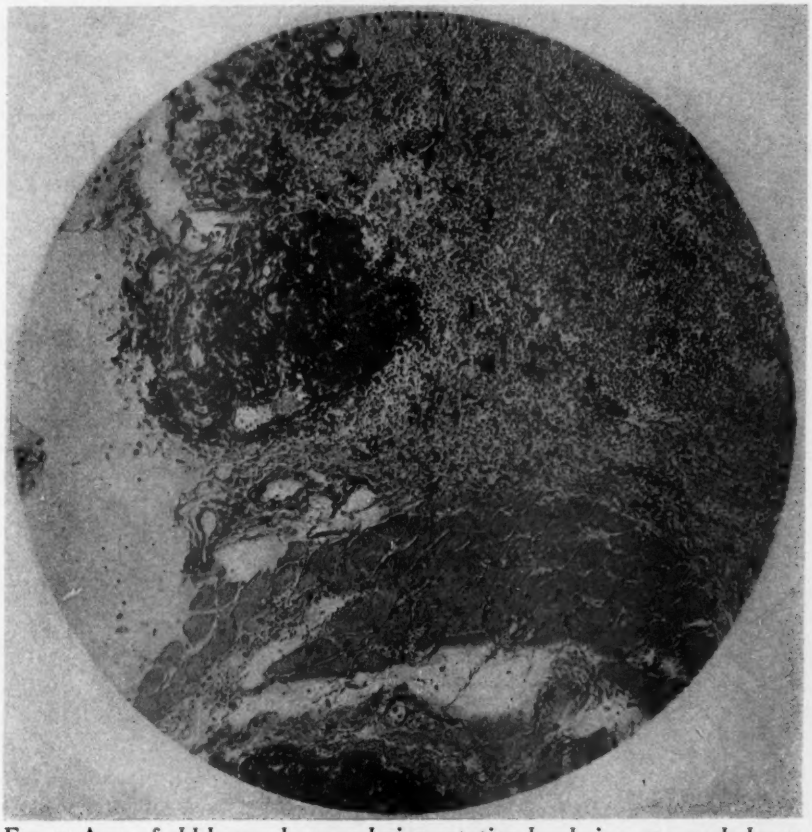

FIG. 3. Area of old hemorrhage and pigmentation bordering on muscle layer.

The microscopic picture showed a layer of flattened epithelium beneath which were several collections of hyperplastic lymphoid follicles separated by fibrous connective tissue. Beneath the lymphoid layer was a group of glandular acini, with an area of cartilage surrounded by fibrous tissue interposed between the two. In the deeper portions of the tumor appeared an area of hemorrhage and pigmentation.

A recent examination of the patient disclosed a scarring of the tongue at the site of operation and area of anesthesia the size of a quarter, with no evidence of local or regional metastasis.

DISCUSSION

Mixed tumors of the tongue are very rare, and as Wood[2] states, they resemble mixed tumors of the salivary glands. Apparently only a small proportion undergoes malignancy. They do not grow very rapidly and tend to produce regional metastasis only.

From the very nature of the growth, such tumors are expected to vary widely in their histologic architecture. All the structures enumerated may be found normally in the tongue. The question arises as to whether this tumor represents a simple hyperplasia of the lymphoid elements with a concomitant fibrosis, located in proximity to an area of cartilage and a collection of mucous glands; or, possessing the two essential characteristics described by Brunschwig, it is a mixed tumor.

SUMMARY

1. Mixed tumors of the tongue are diagnozed on certain criteria established by Brunschwig.

2. The histologic structure found in mixed tumors of the tongue may vary widely, but the essential characteristics will determine the nature of the growth.

3. Tumors of the tongue should be closely scrutinized, as in many cases divergence of opinion will exist as to whether the pathology be one of mere hyperplasia of normally found tissues or real tumor formation.

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PENETRATING KNIFE WOUND OF THE SKULL WITH SUBCORTICAL HEMORRHAGE

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A COLORED man, F. H., aged 28 years, was struck in the occipital region with a clasp knife during a street brawl.

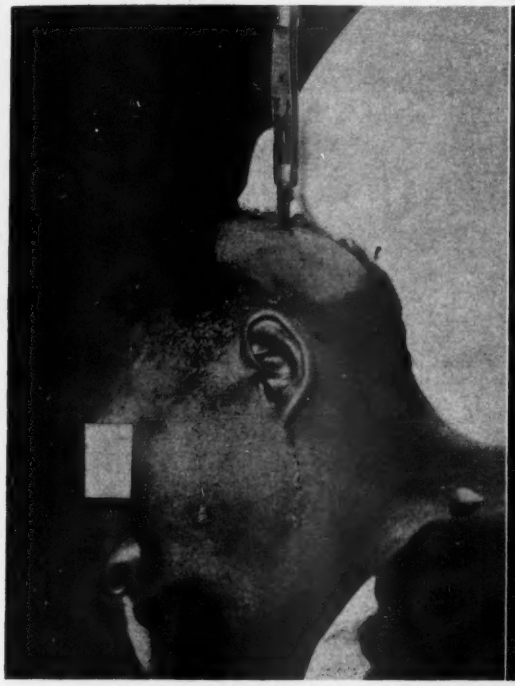

FIG. 1. Pocket knife which has penetrated the skull.

FIG. 2. *X*-ray film showing penetration of knife blade within the brain substance.

He was rendered semi-conscious for a few minutes. He regained consciousness and was transferred to an emergency hospital, and thence to a private hospital.

Complete physical and neurologic examination carried on two hours after injury was entirely negative, except for a slight drowsiness, local pain, and the protruding knife blade. (Fig. 1.) The handle was disengaged from the blade. The patient was given tetanus antitoxin, and immediately transferred to surgery.

A semicircular incision was made in the scalp with a central linear incision. The scalp was stripped away and the knife was extracted through the central incision. A perforator and burr opening was made in the skull, and a small fragment of bone was cut around the knife blade. The depth of the blade, as indicated by the *x*-ray (Fig. 2), was somewhat misleading due to the angle of the film. (Fig. 3.) The dura had been perforated and was under increased tension. The dura was opened wide, and palpation of the brain indicated a soft area underlying the knife perforation. The cortical vessels on both sides of this wound were clipped and the cortex incised. Directly beneath the cortex and extending down for an inch and a half could be seen a large clot, which was evacuated. It contained about an ounce of blood. At the base of this cavity could be seen a large vessel which was bleeding rather profusely. Silver clips were applied to both sides of the vessel and the cavity was washed with saline. The dura was tightly closed and a few small fragments of bone were placed over it. The scalp was then closed with layers of silk and a silver foil dressing applied.

The patient left the hospital in two weeks and rested at home for an additional three weeks. At no time did he have any complaints

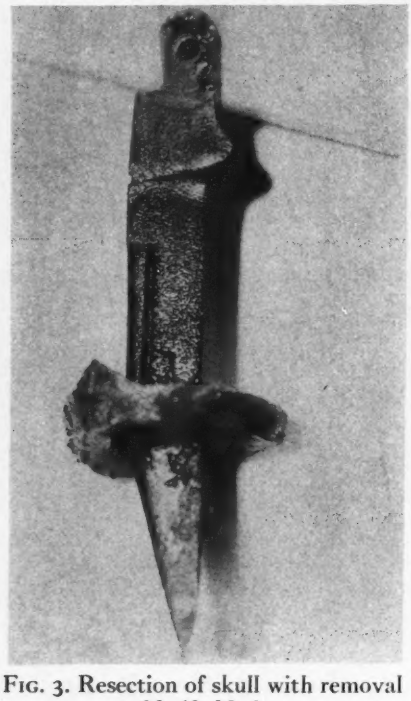

Fig. 3. Resection of skull with removal of knife blade.

and no complications whatsoever occurred. Figure 4 shows the patient three months later, completely recovered.

This case offers some interesting points; the penetration of the skull by a knife thrust; the very short period of semi-consciousness, with

Fig. 4. Two months later, patient entirely recovered. No sequelae.

no complete unconsciousness; and further, the importance of looking into the brain following a penetrating wound of this type. Had the knife been withdrawn, the patient without doubt would have developed a severe hemorrhage which might have proved fatal before the skull could have been opened.

TORSION OF SPERMATIC CORD

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IN discussing torsion of spermatic cord and testis, nearly all writers stress the sudden, increasingly severe and continuous pain. They give the impression that the condition is a progressive one, ultimately going on to strangulation of the cord and gangrene of the testis. This, however, is not always so.

I operated in a case of torsion of a spermatic cord and testis in which the symptoms differed from those usually described, in that attacks of only moderately severe pain occurred at infrequent intervals for a period of more than a year before operation.

CASE REPORT

F. B., aged 14, white, male, is one of a pair of twins. However, while his twin brother has developed normally, the patient has remained markedly retarded both physically and mentally; his condition has been diagnosed as cretinism.

For more than a year before I first saw the boy on September 4, 1936, he had complained intermittently of moderately severe pain and tenderness in the left inguinal region. This pain was short in duration, usually lasting no more than two or three hours, but it was severe enough to make him cry. He had been examined by several physicians who reported that they could feel a small exquisitely tender mass in the left inguinal canal. Between attacks the pain disappeared, but the mass was always present.

When I first saw the patient he was complaining of moderately severe pain in the left inguinal region. Examination showed the penis undersized, the scrotum rudimentary, the right testis small and in the scrotum. A small, tender testis could be felt within the left inguinal canal. My diagnosis was torsion of the left spermatic cord and testis, and I accordingly advised operation. The parents preferred to defer operation, hoping that the boy would recover from this attack as he had from former attacks, and asked to have him watched for a few days. The pain and tenderness continued and after three days the parents consented to operation.

Under avertin anesthesia a typical Bassini incision was made. When the inguinal canal was opened the spermatic cord and testis were found to be swollen, dark blue and boggy. The cord had undergone two complete torsions in a clockwise direction. The necrotic testis and cord were removed, and the small, indirect inguinal hernia repaired. The patient's convalescence was uneventful. Six weeks after operation the wound was well healed and the child had no complaints.

SUMMARY

Because most writers on the subject of torsion of spermatic cord have stressed the severely acute, continuous and progressive nature of the symptoms, I feel that this case with somewhat different symptoms should be reported. The symptoms were moderately acute rather than severely acute, and they occurred at intervals for more than a year, rather than continuously. It seems probable that during this time the spermatic cord had undergone partial torsion and release several times.

NEW INSTRUMENTS

A SIMPLIFIED METHOD FOR MAKING MOULDED SPLINTS

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THE method to be described is one that is recommended for making moulded plaster of Paris splints and reinforcements rapidly and neatly. This method is useful both in the hospital and in the office. An assistant is not needed to keep the ends of the plaster bandage lined up properly. Once the surgeon has measured the extremity to determine the length of the desired splint, the plaster is rolled to exactly that length without the necessity of trimming off any excess. The splint comes off the rack smoothly and evenly formed.

The apparatus consists of a piece of 2 × 4 lumber about 40 inches long, which is fastened to the wall of the plaster room either horizontally or vertically, as space will allow. The vertical mounting will take up very little wall space. This wooden bar has holes three-eighths of an inch wide and 1 inch deep, drilled at intervals of 1 inch. (Fig. 1.) Into these holes are inserted two wooden pins, each three-eighths inch thick and about 8 inches long. Inasmuch as moulded splints are rarely less than 10 inches in length, the first nine holes are omitted, and only the holes for splints measuring from 10 to 36 inches are drilled. The holes are numbered for the proper distances. The pins are placed in the holes which correspond to the length of the required plaster splint.

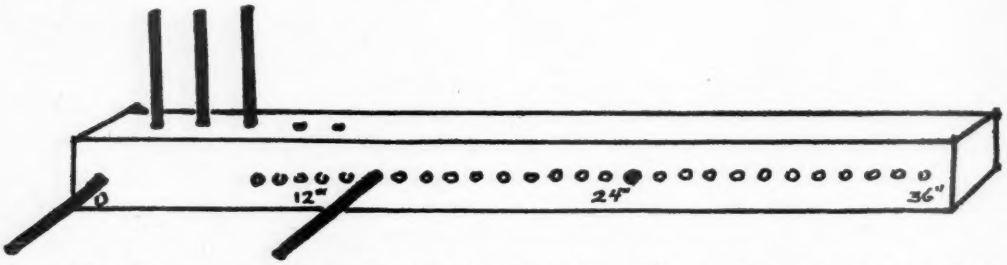

FIG. 1. Wooden bar mounted on wall with pins placed for making a splint 14 inches long. Spare pins are on top of the bar. Shelf for catching plaster drippings is not shown.

It is suggested that some holes be drilled into the top of the wooden bar so that the two pins (and extra ones) may be stored when not in use. This will avoid their being broken off by passersby. It is also suggested that a shelf about 10 inches wide and about 4 feet long be built beneath the apparatus to catch the dripping plaster and thus avoid messing walls and floor and aid in keeping the room clean. This shelf may be mounted on hinges so that it can be folded out of the way when not in use. For the vertical mounting, the shelf need be only one foot square.

When the desired length for the molded splint is ascertained with a tape measure, the pins are inserted at the proper distance and the operator starts rolling the plaster bandage over them. (Fig. 2.) The plaster may be rolled while dry and subsequently immersed in water for the softening process. This will avoid splashing of plaster. When the required thickness is obtained,

the pins are removed and the moulded splint is slipped off and applied either directly on the limb, or placed on lint or padding prior to application to the fractured extremity.

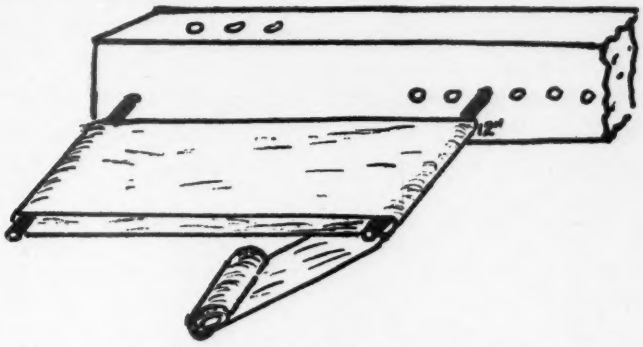

Fig. 2. Formation of splint by rolling plaster over pins.

The apparatus will be found useful in cutting dry rolls of plaster into strips of suitable length which may be stored and used as occasions arise. As many lengths of accurately cut plaster strips as necessary may be used.

Should splints longer than 36 inches be needed, as for example one 48 inches long, one may mould a splint half this length and cut it across at only one end before removal from the pins. This avoids having an apparatus of excessive length taking up too much wall space in the plaster room. For ordinary use the 40 inch wooden bar will be sufficient.

The apparatus will cut the cost of plaster, for the ease with which splints are rolled will permit closer application of succeeding layers and will give the splint greater strength. It will be found that two rolls will do for a given splint where three were formerly required; also, there will be less waste since we may avoid constructing excessively long splints which require subsequent trimming.

The cost of the entire apparatus should not be more than twenty-five cents, as it may be made from scrap lumber.

A NEW SELF-RETAINING ANOSCOPE

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THERE are many types and varieties of anoscopes now in use, each possessing features which are preferred by some physicians and rejected by others. The number of types available proves that we still do not possess an ideal instrument which would supplant all others and could be used both in examination and in treatment of the anal canal.

The most satisfactory anoscopes now in use are of the tubular or conical variety with a slide (fenestrated), or with an oblique opening. Unfortunately these instruments are not self-retaining. The physician working without any assistance is obliged to retain the anoscope with one hand, while the other must perform all other manipulations. The end of this inconvenience would certainly be highly appreciated, even by those who have ample assistance.

The self-retaining anoscope here presented has no original features, but is an adaptation of the best features from the most widely used apparatus with an added device which makes it self-retaining. This instrument can be used in the examination of the anal canal without an anesthetic.

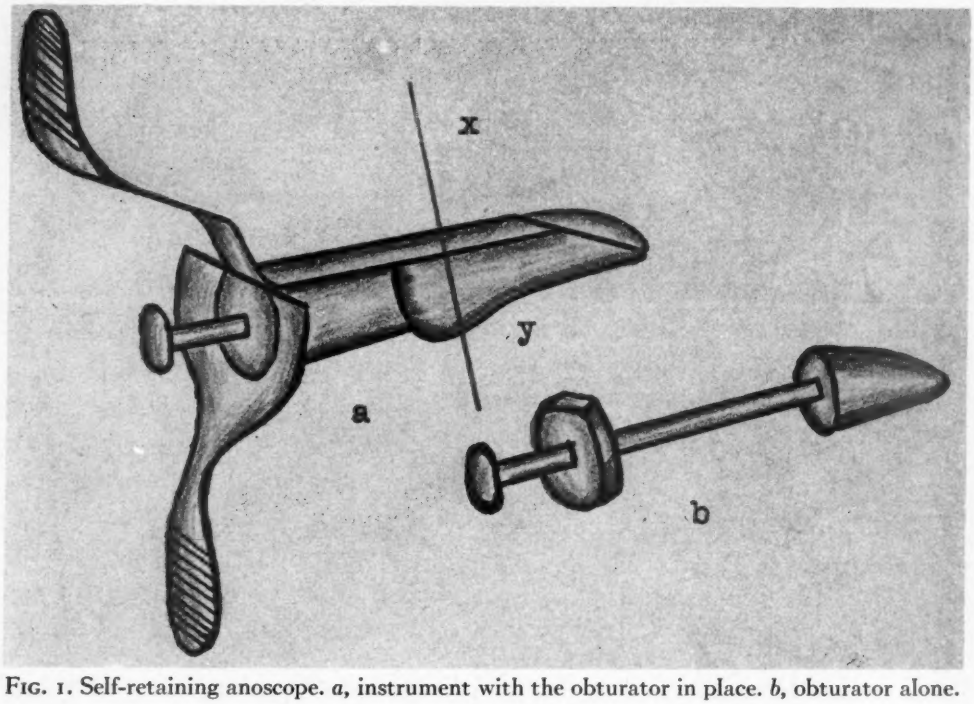

FIG. 1. Self-retaining anoscope. *a*, instrument with the obturator in place. *b*, obturator alone.

Many leading proctologists are now using the Smith self-retaining operating anoscope, an excellent instrument of the "bivalve speculum" type. However, it cannot be used unless the anus is completely anesthetized; without an anesthetic, it becomes an instrument of torture.

The present anoscope is based on the instruments devised by Martin, Hirschman, Goldbacher and Gant. From Martin's and Goldbacher's anoscopes it features the fenestration when the slide is withdrawn, and from Hirschman's the oblique open-

ing. The self-retaining device also is not new as it was used by Gant.

The slide permits the inspection of the walls of the anal canal, injection of hemorrhoids, applications to the mucosa, operative or other treatment for fissures, fistulas, crypts, etc. The oblique opening, considered by many proctologists of distinct advantage over the fenestrated type for the injection of internal hemorrhoids, may be used when preferred. The slide may be withdrawn or not, depending on the type of ailment to be treated and the preference of the physician in the particular instance. The advantages of the self-retaining feature are obvious.

The anoscope consists of a conical tube 3½ inches long. The diameter of the proximal end is 1 inch, the distal ¾ inch. The distal end is oblique, making the section an ellipse and the shorter test element of the cone 1¼ inches shorter than the longer one. The proximal end is fitted with a flange. At a distance of 1¼ inches from the proximal end, there is a conical dilatation the base of which is 1⅛ inches in diameter. This dilatation is gradually diminishing towards the distal end to fuse with the original cone at a distance of 1 inch from its origin. The slide runs through the entire length of the tube at its shortest element for 2¼ inches and is ⅝ inch wide. The slide opens together with a part of the flange at the proximal end, leaving a part of the anal margin unobstructed. The conical dilatation of the tube, which makes the anoscope self-retaining, does not involve the slide. The obturator has a slanting end which facilitates the introduction of the instrument and snugly fits its distal end. The instrument has two handles, one for the slide and the other for the main part, to facilitate its manipulations. (Fig. 1.)

Fig. 2. Section of the anoscope through the dilatation of the self-retaining device (line *x-y* of Figure 1).

CONCLUSION

A new self-retaining anoscope is presented. It has certain advantages over the ones in use as it combines the features of the fenestrated anoscope with the oblique distal opening and is self-retaining.

It can be used in examination of the anal canal without an anesthetic and renders treatment easier by being used according to requirements as a fenestrated or a nonfenestrated anoscope.

It is easily introduced, does not slide out when patient strains or coughs, can be rotated (advisable only when slide is in place), and is easily withdrawn.

This instrument will hardly replace the ones now in use. However, it renders work in proctology easier and provides an instrument with somewhat wider utility.

A METHOD OF MINIMIZING TRACTION TRAUMA IN RECTAL SURGERY

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WHAT the compass is to the sailor, landmarks are to the surgeon. As a result of the recent rebirth of interest in regard to the anatomy of the anorectum brought about by Hiller,[1] Milligan and Morgan,[2] Edward Levy,[3] and others, the importance of landmarks is realized for the first time by the rectal surgeon. The purpose of this article is to describe a method of surgical treatment which utilizes the landmarks of the anal canal as guides and, at the same time, minimizes the trauma due to the operation itself, that is, "traction trauma."

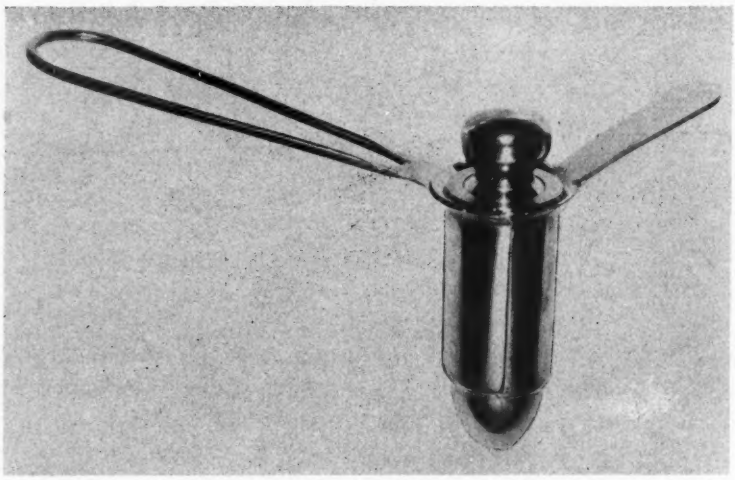

FIG. 1. Resectoscope ready for insertion. Note that handles are wide apart to keep the instrument closed.

That the sphincter is divided by, and that muscle-spaces are formed by fascial extensions from the levator ani and the external coat of the bowel is generally known. Also, the fact is appreciated that certain components of the levator ani have a physiologic role in regard to sphincteric control. What is not generally known is that the landmarks within the canal furnish the key for surgical entrance into the surrounding muscles and spaces for the purpose of creating rest and drainage. Recognition of the dentate line, intermuscular septum, and the puborectalis muscle is a necessary prelude for accurate surgical treatment of such anal infections as fistulae, abscess, hemorrhoids, fissure, and cryptitis.

Aside from the cases of severe rectal pathology in which all tissue is distorted, the surgeon may usually be guided by landmarks. In advanced cases of rectal pathology with atonic sphincters, prolapsed membranes, and tissue distortion from chronic inflammation, the problem of the rectal surgeon becomes difficult indeed. "In these cases," says one eminent proctologist "the judgment of Solomon scarcely suffices to tell how much tissue to remove and how much to leave."[4]

In most rectal operations, however, landmarks are deliberately destroyed. Here, where the sphincter is extensively dilated or divulsed, and the mucous membrane is

drawn down and everted from the anal canal, we have immediate and remote difficulties for both patient and surgeon.

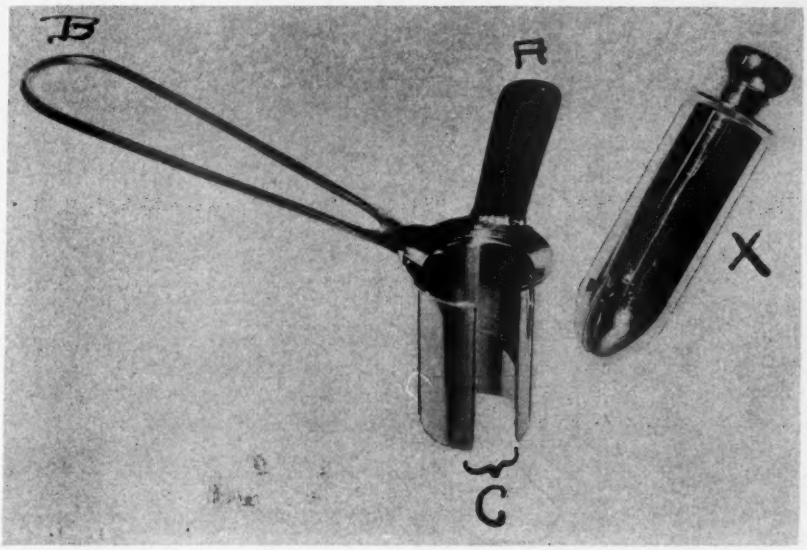

Fig. 2. After insertion, obturator, x, is removed. Handle a, which is attached to the inner hemicylinder, is rotated toward handle b, which is attached to the outer hemicylinder. Thereby a corresponding opening is secured at c.

This "traumatic traction" causes damage. The muscle fibers of the sphincter are broken. The blood vessels and nerves of the hemorrhoidal plexus are ruptured. Portions of the mucous membrane are avulsed from the bowel wall. There is an extravasation of blood into the perianal tissues with ensuing tissue distortion. Here, again, we are unable to judge how much tissue to remove. The remote difficulty is for the patient in the form of increased postoperative pain and disability—and often a poor result.

Traumatic traction may be minimized by applying the surgical procedure within the anal canal.[5] The necessity for strenuous dilatation of the sphincter and avulsion of the mucous membrane is thus avoided. An instrument that will provide adequate exposure of the anal canal for routine surgical procedures without producing trauma will remove the immediate and remote difficulties to which we have referred.

Such an instrument is shown in Figure 1. It is termed a resectoscope for the reason that it is a surgical instrument, in contrast to the anoscope which is for the purpose of examination. It is composed of two hemicylinders of tempered steel—the inner being encompassed by the outer one—and an obturator. After inserting the instrument (as an ordinary anoscope) and withdrawing the obturator, an arc of the anal canal may be exposed from 0 to 190 degrees

Fig. 3. Resectoscope inserted. Patient is in prone semi-inverted position. Hemorrhoid in left anterior quadrant is being ligated.

by rotating the handles which are attached to the hemicyclinders. This feature of adjustability is of great advantage for it allows the pathologic tissue to prolapse into the opening which can be adapted to

receive it. At the same time, adjacent tissues are withheld from the operating field.

That there is sufficient exposure afforded by this instrument for the adequate surgical treatment of ordinary anorectal pathology is attested by an abundance of clinical experience. By its use anal infections are effectively treated. For example, the demarcative line between normal membrane and hemorrhoidal tissue may be clearly visualized when performing hemorrhoidectomy. The incisions for removal of a chronic anal ulcer may be made with precision through the space exposed. Crypt openings at the dentate line are accessible for the passing of a probe in cases of "blind" or complete fistulae. Crypts and papillae are easily removed.

Although the technical difficulties are increased to a certain extent by this method there can be no doubt that the advantages to be derived compensate adequately. The necessity for acquiring a slightly increased dexterity of surgical technique will be amply rewarded by the increased welfare of the patient.

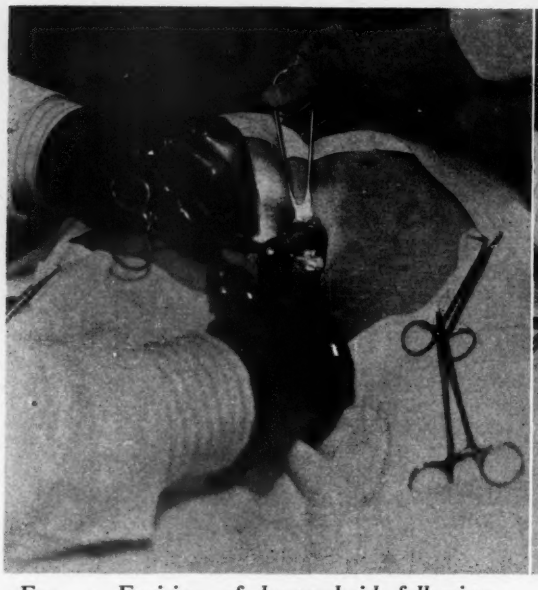

FIG. 4. Excision of hemorrhoid following ligation.

FIG. 5. Closure of wound margins after excision of hemorrhoid.

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[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

INCUNABULA MEDICA*

THE YEAR 1000 A.D.

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WHERE to begin in a chronicle of the medicine of the early centuries is perplexing. Each century since the dawn of the Christian Era furnished one or more personalities who stood out head and shoulders above their contemporary confrères. Generally this prominence had been attained because of unusual intellectual capacity as exemplified by the origination of an idea or theory, then the elaboration of such an idea into something of practical use in the treatment of the sick. When such was not the case we find men attaining prominence because of unusual technical skill in some surgical procedure.

As an illustration, there were the endocrinologists of the times, who fed fresh gonadal tissue to their patients for relief of impotence, the internists who took their anemics and tuberculous directly to the site of slaughter of oxen and forced them to eat of the fresh raw liver and to drink of the warm fresh blood of the animal.

Theirs was not to reason as to the why or the wherefore, nor to elaborate involved and usually conflicting hypotheses as to what took place. They only knew that something happened to a certain percentage of their patients after such therapy. They were better, they felt better, they looked and acted better. What more could the medical man ask for than therapeutic confirmation of what he was using?

From the surgical aspect we find the practitioners of these times paying strict attention to the preparation of suture material, soaking this in strong wine and spirits over a long period of time for antisepsis and being particularly proud in their perfect approximation of wound edges in order to produce suture lines which were scarcely visible when healed. As to personalities, one finds that a Paulus, Bishop of Merida, performed cesarean section, not once but many times during the middle of the sixth century and history corroborates that his mortality was low.

In the seventh century, an accurate and most adequate description of a carbuncle of the neck is found, stressing the multiple chambers and recesses characteristic of such a condition and advocating long, deep, and extensive crucial incision as appropriate therapy.

*This is the first of a series of papers which will present descriptions of medicine and its leading exponents in the Middle Ages.

In the tenth century, a female physician, Trotula of Ruggieri, was summoned in consultation all over Europe to perform the operation of perineorrhaphy.

Roger of Salerno and his pupil, Roland of Parma, flourished during the eleventh century, the former noted as the greatest surgeon of his day, who unhesitatingly performed trephining of the skull in cases of injury or fracture producing pressure.

To him also we are indebted for the first description of contrecoup fractures, and many were his difficulties in putting across the idea that a blow could be on one side of the head and the actual fracture on the opposite. The skeptics of the time were hard to convince.

In the same century, we find one Gariopontus describing lung abscess as follows: "A painful molar tooth being extracted by an inexperienced physician, a friend of mine, a philosopher, was done to death, because the marrow of the tooth when extracted, along with the surrounding pustulous matter, ran down into the lungs, causing a fetid and putrid process of such a stench that none could remain in the same house with him."

We find these physicians using an infusion of mandragora and opium as an anesthetic to produce a deadening intoxication, also the vapor from a distillation of hemp seed.

One could go on and on indefinitely citing such examples of effort and endeavor. Arbitrarily the year 1000 A.D. has been chosen from which to make a start in the story of the Incunabula Medica.

The year 1000 A.D. represents almost a definite line of cleavage in the story of the progressive march of medicine. Medicine first began to assume more practical aspects at this time. These steps in progressive medical change will be described as the story of the events leading up to them is unfolded.

Perhaps first it is best that a definition of the term "incunabula" be given, that what follows may the more easily be understood. This term means literally "cradle books," the very beginnings of books, the foundation stones, and is taken to include all books published from the year 1456 when printing was discovered to the year 1500 inclusive.

An impressive number of the books published during this period pertained to medicine, and it is these that we shall be interested in.

Prior to the year 1456 all available medical literature existed only in manuscript form. These manuscripts were the work of scribes, each trying to outdo the other in perfection. Some of the illumination is so perfect in its sheer beauty that it is almost beyond belief that it could have been done by a human hand. The perfection of line is evident in almost every single manuscript. It was rare, however, for any manuscript to exist in any one place in its complete form. Because they were so sparse and therefore available to only a few, they were divided into parts, in order that more individuals might have access to their use. The surgical manuscript of Roger of Salerno, as an example, existed only in parts—Part I, devoted to the surgery of the head; Part II, to the surgery of blood vessels, particularly veins and outlining the operation of phlebotomy; Part III, examination of the urine, and so on.

Thus it became the province of the earliest typographers to gather together many parts of a manuscript in order that they might print as complete an opus as possible. It is because of losses through fire, confiscation, and such, that many of the early printed incunabula have such gaps in their content. For multiple reasons the typographer could not locate the missing parts or obtain access to them.

There had been many famous and great doctors prior to the beginning of this eleventh century. These doctors were usually members of various religious orders, the Franciscan, Benedictin or Dominican, and the medicine and religion of the time were closely interwoven. Very little is known with regard to the lives and medical

contributions of many of these doctors. How much they may have contributed of value, which was subsequently lost to posterity, is intriguing to speculate upon.

Here and there had existed individuals about whom history has recorded little, but who seemed each to represent a sort of fountainhead of knowledge and to whom a few pupils would come to study. These pupils would then migrate and spread out into other parts of the world, carrying with them the teachings of their master. Many were of sufficient intellectual capacity as to be able to acquire more knowledge through their own deep reasoning and by their own diligent study. These pupils in their turn would often become masters and great teachers, with the result that a wide dispersion of their own knowledge took place through their successive pupils or students.

The association of medicine and religion had always existed from earliest tribal times where the "healer" of the tribe was the most important and presumably the wisest individual. Jesus Christ himself was a practitioner of medicine when he performed the miracles of healing in association with preaching of religion to the multitudes. The association of religion and healing is today still exemplified in varying forms of worship all over the world.

A possible reason for the meagerness of our knowledge of ancient literature and of ancient science, as well as of the early contributions made during the first ten centuries of the Christian era, can be laid to the attitude of varying religious groups, more particularly of the Catholic Church itself, as it then existed. Much has been written refuting this, but impartial and unemotional reading and study cannot help but substantiate such a conclusion.

The rule and the custom of the year 1000 were that ancient civilizations should be forgotten and obliterated, except for such meager fragments as might be adapted to some selfish purpose. Everything of literature and science considered as non-conforming was to perish—one of the many examples in history, of the sadistic tinge of the Church, which in theory preached against the individual practice of that very thing. The extremely fortunate few who managed to acquire any degree of education or knowledge were taught to scorn that knowledge which had come before them and to lay emphasis entirely upon that which was of the present and to come. Only this could be good for the mind and best for the soul. Lest you become too ardent a believer that human biology has changed for the better, is not contemporary thinking and teaching much along this same order? Emotionalistic interpretation of all things without regard to the lessons of experience written down in history is most assuredly the order of our own day.

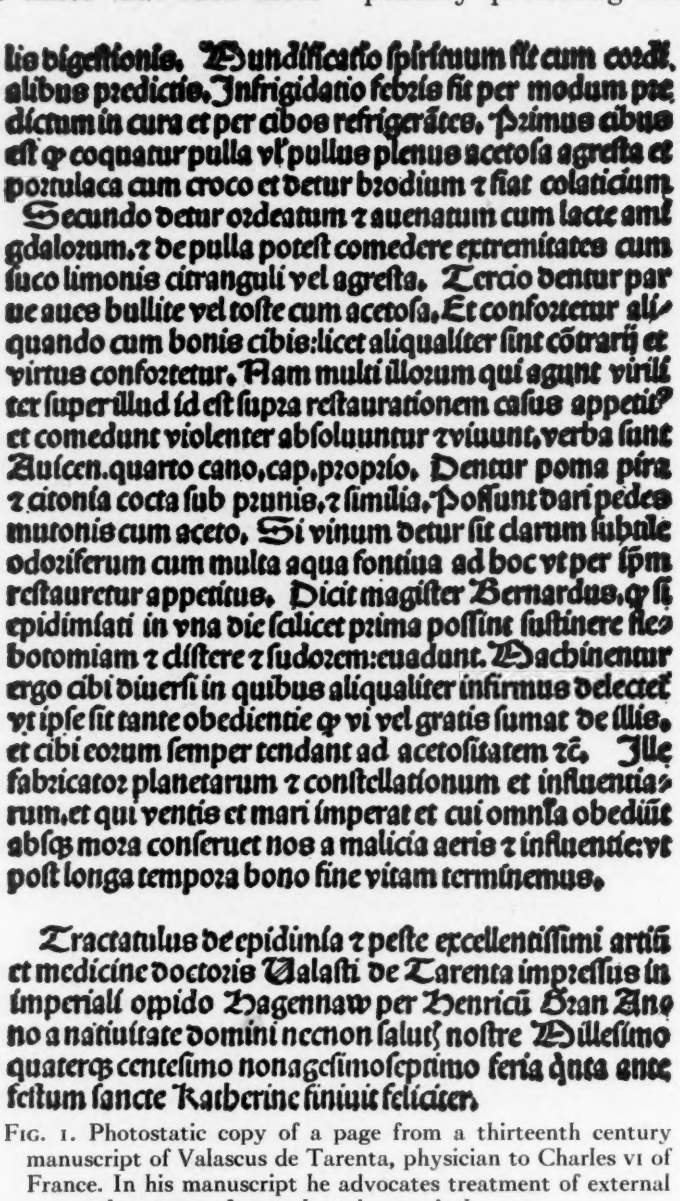
It was about the year 1000 A.D. that nursing as a practical working institution first came into being. There had always been the nursing of a member of a family, of a friend, even of an individual in distress, by someone else, but organized nursing by a group actually instructed in the practice, took place first at about this time.

The establishment of the first monastic order took place about 300 A.D., but the actual flowering and growth of such orders began to make definite headway about seven hundred years later. The year 1000, therefore, represents a rather definite time spot from which to make a beginning in a story of early medicine.

These various religious orders, both male and female, took over, as one of their first functions, the care of the sick of a community. Theretofore the care of the sick had been haphazard, taken care of mainly by small groups of volunteer workers, usually men and women who attached themselves to some lordly bishop's retinue and existed much as hangers on. They were assured rather precariously of just sufficient to keep body and soul together, although it was mainly the soul that was taken care of. The body depended upon scraps from the tables of the higher

ups or upon whatever foraging into the surrounding countryside could produce.

It was in these times that such assinities of human conduct took place as the kissing of the unwashed feet of beggars as a token of humility. Communal dividing of ill luck as well as good, gave birth to the idea of lying down beside a leper to share his burdens, and to the kissing of those afflicted with the plague. These practices are only a few examples of the means whereby numbers of people unwittingly went to their God, but in the belief that there was a reward. Most definitely so. All who died in such manner, openly and publicly professing their humility, upon dying became angels. Could one possibly ask any greater reward?



lis digestionis. Mundificatio spirituum fit cum cordi. alibus predictis. Infrigidatio febris fit per modum pre dictum in cura et per cibos refrigerātes. Primus cibus est q coquatur pulla vl pullus plenus acetosa agresta et portulaca cum croco et detur brodium t fiat colaticium. Secundo detur ordeatum t auenatum cum lacte amy gdalorum. t de pulla potest comedere extremitates cum suco limonis citranguli vel agresta. Tercio dentur par ue aues bullite vel toste cum acetosa. Et confortetur ali quando cum bonis cibis: licet aliqualiter sint cōtrarij et virtus confortetur. Nam multi illorum qui agunt virili ter super illud id est supra restaurationem casus appetit et comedunt violenter absoluuntur t viuunt, verba sunt Auicen. quarto cano, cap, proprio. Dentur poma pira t citonia cocta sub prunis, t similia. Possunt dari pedes mutonis cum aceto. Si vinum detur sit clarum subtile odoriferum cum multa aqua fontina ad hoc vt per ipm restauretur appetitus. Dicit magister Bernardus, q si epidimiati in vna die salicet prima possint sustinere fle botomiam t distere t sudorem: euadunt. Machinentur ergo cibi diuersi in quibus aliqualiter infirmus delectet vt ipse sit tante obedientie q vi vel gratis sumat de illis. et cibi eorum semper tendant ad acetositatem tc. Ille fabricator planetarum t constellationum et influentia rum, et qui ventis et mari imperat et cui omnia obediūt absq mora conseruet nos a malicia aeris t influentie: vt post longa tempora bono fine vitam terminemus.

Tractatulus de epidimia t peste excellentissimi artiū et medicine doctoris Valasti de Tarenta impressus in imperiali oppido Hagennaw per Henricū Gran Ano no a natiuitate domini nec non salutis nostre Millesimo quaterq centesimo nonagesimoseptimo feria q̄nta ante festum sancte Katherine finiuit feliciter.

Fig. 1. Photostatic copy of a page from a thirteenth century manuscript of Valascus de Tarenta, physician to Charles VI of France. In his manuscript he advocates treatment of external cancers by means of an escharotic arsenical paste.

Among the first religious orders founded, the Benedictins, for no particular or valid reason, were much interested in medicine and had acquired and collected a substantial number of ancient manuscripts pertaining to medicine. They had then delegated those members of their order best qualified to the task of translating

these manuscripts and others to the task of studying and interpreting them in a manner satisfactory to the religious philos-

Fig. 2. A page from a manuscript of Roger of Salerno, outstanding surgeon of his time. His description of head injuries, trephining operations on the skull, and the contrecoup fracture could be improved upon but little even in this day.

ophy of the order. From this group of translators and searchers there arose a certain number of men who possessed a little above the average as to knowledge. They learned what to do in certain types of illness or injury as laid down in the rules for medical procedure found in the manuscripts of the ancients. These monks probably represented the first actual practice of medicine by an organized group, or one could say by a school of learning with a definite curriculum of study.

To the casual reader, the word "monk," of itself, is apt to convey a quick impression of a very learned scholastic gentleman who had renounced everything worldly in order to gain the peace of soul and mind which comes from solitary communion with oneself and God and knowledge. This picture is rather far from the actual and less vivid one.

The monk was, after all, a human being, of flesh and blood like all others, subject to the same instincts and emotions and biological urges. History records that many of them were rogues of the highest order. More often than not he was a very ignorant individual, but as time meant absolutely nothing to him, he often allotted his full lifetime to deciphering, translating, writing and illuminating one single solitary manuscript. He sometimes learned something during this labor, or at least he should have.

But more often he was actually entirely ignorant of what he was doing. He could translate words singly but not a group of words into an idea as a whole.

Let us assume, for the moment, that being human, he had a splitting headache or a bad case of indigestion or, more materially, a hangover from too much wine the evening before. From the historical accounts of the mode and manner of living of monks, and from paintings of the era, handed down to later generations, it is rational to deduce that many of them were gluttonous in their habits, and therefore prone to cirrhosis of the liver and gall-bladder dysfunctions and the symptoms produced by these disorders. It is possible that they would be more prone to hand down pessimistic or melancholic interpretations of difficult lines than would other individuals with clear heads and normal digestions. Voltaire and Napoleon expressed trite opinions as to the head work of men under different states of digestive function. On what flimsy pedestals may the pillars of knowledge lie? How much could such a monk conveniently have forgotten or omitted in his translation because he didn't feel like working that day, or how many remedies for headache and indigestion did he leave out intentionally because he had tried them in his own individual case and they had not worked? In other words, how much did human foibles and weaknesses influence the actual amount of knowledge handed down to posterity out of these early repositories of knowledge? How much was lost or misplaced?

That the monk, however, could be very materialistic is amply demonstrated.

When he completed his labor he often signed at the end, "Deo Gratias"—"Thank God," but then the spiritualistic and the materialistic parts of his personality split, and one rose to the surface, for he sometimes added as a sort of postscript, "For this my labor, O God! of thy goodness bestow upon me many hats and caps, cloaks and coats, she goats and he goats, sheep and cattle, and a handsome wife without children." So, after all, he was rather a practical fellow.

The idea of taking a sick individual from his house to a separate place of abode for the treatment of disease first arose at about this time, also as the result of the pilgrimage of the Crusades. En route to Jerusalem, of the thousands of pilgrims many became ill on the way, and, of necessity, a place had to be found to take care of them.

The survival of just such a custom from olden time to present day is best illustrated in our rural inaccessible districts, where many a physician takes his severe cases into his own home for better and more constant attendance and care.

During and after the Crusades, for one reason or another, leprosy became quite widely disseminated throughout Western Europe, and a need arose for some sort of asylum in which to segregate people afflicted with the disease. They could not indefinitely continue to live like dogs outside city gates, existing solely on the meager crumbs they could obtain by begging. Begging in itself was difficult and unproductive of results, since most people fled whenever a beggar approached who in the distance appeared to be a possible leper. It has been estimated that during the Middle Ages over 19,000 of these asylums for segregation, called leprosariums, existed in Europe and Africa. They constitute one of our first examples of public health and preventive medicine. Some have survived the toll of time and exist into the present day as true hospitals. The Allgemeines Krankenhaus in Vienna is an example of this.

From the sixth to about the eleventh centuries there had existed some so-called "regular physicians." These were laymen and did not belong to any of the religious orders. The main qualifications of these gentlemen were that they were skilled in uroscopy, the latter consisting mainly of squinting very long and learnedly at a flask of urine, noting its color, the amount,

and then tasting it, detecting acidity, sweetness and such. That represented more or less the sum total of the science and art of uroscopy.

A second qualification was that they must be able to read. Reading was considered an "art" and if one could merely read, regardless of how little, he was classified as a "scholar." This ability to read, however, was a very important turning point in the history of medicine. The very wealthy who had access to manuscripts and collections of writing contained in their libraries were too indifferent or too lazy or too taken up with their own importance, to bother to learn the art of reading. Then, as today, the ownership of a large library was an essential step in demonstrating one's wealth in goods, and helped classify an ignoramus as a patron of literature. The poor who might desire to become scholars had no access to writings or manuscripts except through the religious orders. In a short space of time these orders therefore controlled who should and who should not acquire the art of medicine, of mathematics, astronomy, or philosophy, and they used this "cornering of the market" solely and completely to their own uses and advantage.

The monasteries then devoted branches entirely to the practice of medicine; the men so chosen were called "medici." A little later on, one reads of "fisiceans" and "serorgiens" in the regulations and statutes of various established hospital staffs, as they have come down to us.

What the stock in trade of these "medici' consisted of, their armamentarium for the curing of disease, was about as follows:

First, and foremost, prayer, and the exorcism of devils. A loud voice and the ability to dance in contortions of extreme degree were attendant virtues.

Secondly, multiple forms and shapes, some symbolical, some not, of armlets and rings which were to be worn in some manner in or about where the ailment was seated. Some of these were worn in a preventive and prophylactic capacity to ward off and prevent the disease. These rings and armlets were made of metal, of tanned hides, of hair, or of leaves and branches of trees and shrubs.

Thirdly, herbs, gathered under varying zodiacal signs and influences, the moon in its proper phase, etc., then, finally, consecrated only by the priests themselves, otherwise efficaciousness was denied.

Fourthly, certain saints were "patron" saints of certain diseases, such as toothache, earache, etc., therefore, prayer was to be particularized and addressed to that certain designated saint if such a part were affected.

Fifthly, mineral stones, charms of various shapes and hues to be worn about the body or held in the hand. This latter custom has survived into our present day in certain foreign quarters of our large cities. Very respectable incomes are gathered by the dispensers of such.

To sum it all up, two characteristics stand out boldly in this armamentarium, gross superstition and blind unquestioning faith.

Nine hundred years later we see an enlightened (or at least a presumably enlightened) section of our own population existing under almost identical conditions. Superstition, exactly the same as that of old but clothed in the more modern speech of the modern faker, and faith, an incredulous blind stubborn indifference to thinking for oneself and a willingness to be led blindly. And yet, one could wager that the mortality rate in this group today, if such interesting statistics were possible to obtain, would show that the ancients' rate was lower because their faith was more simple, more blind, more primitive, and therefore, more honest.

If severe epidemic diseases such as leprosy, the plague, etc., occurred, decimating populations, these "medici" could never be accused of ignorance nor of dumbness. They merely avoided all responsibility by shouting from the housetops and

preaching everywhere that the Jews were responsible for the deaths because they had poisoned all the wells. Certain wells would then be tested publicly, accompanied by great ceremony and fol de rol, and found to be unfit for use, a certain number would be condemned and made unavailable for a time, a pogrom against the Jews was instituted, and there you had it—the solution. Could it be possible that the wells had been prepared beforehand for such public examinations in such manner as best suited such nefarious purposes? Attention was directed away from their own ignorance and incapacity into another direction. It didn't seem to matter, or perhaps nobody inquired, how it came to pass that these wells would be in use again after the plague had passed on.

It seems as though some of our master minds of today, particularly in the realm of politics, must have read or become acquainted with this technique of the ancient "intelligentsia" because they are using it to great effect in our own times, and with the same degree of success.

But the monks or "medici," drunk with their own power and position, began to indulge to such a degree in gross abuses—gluttony, extortion, blackmail, rape—that they became a sore spot and a liability to the Church. Conditions became so bad that in 1138, at Rheims, an edict was issued that the study of medicine and surgery in the monasteries was forbidden for the time being. From time to time up to 1250, similar edicts were issued at intervals.

Human biology and human characteristics being then about the same as today in their personal reactions, some of these monks continued to practice surreptitiously. The financial and bodily returns were sufficiently great as to justify the greed. Some of these doctors were most enterprising and in their own particular specialty stood out above those around them. They had advanced entirely on their own to the use of the actual cautery, live coals being used as the cauterizing agent. Some had become quite skilful in the use of the knife or scalpel itself.

As an illustration of some of their attainments, Paulus of Merida, mentioned previously, performed the first cesarean section upon a living female, whether successfully or not is not known. Another, Theodorus, a Greek, was an expert at venesection; Notker of Prague, an expert on uroscopy; and a female physician, the Abbess Hildegarde, enclosed all of her remedies and herbs in a coating of dough, usually sweetened thoroughly, then baked in the form of little cakes or biscuits, and eaten. Nine hundred years ago, but what's wrong with that as a vehicle for bad tasting or noxious drugs? Hildegarde was quite proficient in materia medica, and was the supposed possessor of over two hundred secret formulae, all of which she dispensed in the above manner.

The libraries of the times consisted of written manuscripts which were handed down by inheritance, kept in the family for generations, and owned only by families of great wealth.

Perhaps the greatest scholastic influence upon medieval medicine were the three great schools of medicine of the time, that of Montpellier in France, one at Monte Cassino in Italy, and the school of Salerno, also in Italy.

Monte Cassino was founded by St. Benedict himself, and although it was against the newly announced principles of the order, the practice of medicine was encouraged and the school became much like a great clinic. The sick and ailing came from far and wide so that in reality the institution was forced to take upon itself the actual practice of medicine rather than the teaching of it.

As each abbot succeeded as head of the school, it was his custom to write a long treatise on the miraculous cures which had occurred under his leadership. About 1050 a great hospital was built at Monte Cassino and monks began coming from all quarters of the globe as students of medicine. The

story of Monte Cassino is of tremendous interest but does not lie in the sphere of this story.

The most famous of all of the monks who came to study at Monte Cassino was one Constantinus from Carthage, in Africa, therefore called Constantinus Africanus.

The Benedictins were responsible for putting medicine on the more solid and firm basis it acquired shortly after the year 1000. Their order had been founded about 500 years earlier but it is from this time on that they struck their stride and their work began to attract world attention.

In their monastery libraries were many of the writings of Hippocrates, translated into Latin, similar translations of Galen and Dioscorides, of Caelius Aurelianus, and an unknown quantity of manuscript matter of unknown origin and authorship, but all pertaining to medicine. Certainly an excellent foundation stone on which to build, and they did build. It was the availability of these old manuscripts for study which caused Constantinus to trace his steps toward Monte Cassino.

Shortly after arrival he was to stand out among all others there, because of his sheer intellectual ability. His life story is of sufficient interest to men in medicine to be repeated again and again, and will be a part of this series.

During the Napoleonic Wars, a French army surgeon by the name of Dominique Jean Larrey instituted so-called "flying ambulances," which permitted quick care of the wounded after their injuries and prevented innumerable deaths from infection from wounds contaminated in battle. His work led to the formation of the ambulance corp as it is known today. (Burbank)

The brief excerpts in this issue are taken from "Landmarks in Medicine," a volume of lectures to the laity given at the New York Academy of Medicine in 1938 (published by D. Appleton-Century Company).

BOOK REVIEWS

MODERN SURGICAL TECHNIC. By Max Thorek, M.D. Three volumes, with a foreword by Donald C. Balfour, M.D. Philadelphia, 1938. J. B. Lippincott. Price $35.00.

This work, one of the important publications of the year, is sure to receive a royal welcome from the profession. The author says he felt that "there existed a genuine need for a succinct work on surgical operations, up-to-date as regards important advances in surgical technic and including, in order to be practical, a sufficiently detailed description of each procedure in all commonly performed operations." With these thoughts in mind he has written three volumes to supply this need.

The highlights of surgical anatomy occupy a goodly space. Also, such operations as amputations, ligation of blood vessels, fractures, dislocations, etc., are amply dealt with. The step-by-step (the most practical) method has been adopted in describing operations. This is especially helpful to the surgical intern, the neophyte, and the young assistant.

The illustrations (2,174 in number) are modern and far above the average. Most of them are by Mr. W. C. Shepard, outstanding in his field.

Volume I is divided into two parts, the first of which deals with general operative considerations, covering such interesting chapters as "The Surgeon and His Art," "The Surgeon and His Patient," "Operating Pavilions and the Operation in General," and "Anesthesia." Part Two covers surgery of the head and neck and plastic surgery. The second volume contains Parts Three and Four: Part Three has to do with the surgery of nerves, vessels, and bones, while Part Four deals with surgery of the breast and chest. Volume III contains Parts Five and Six. Part Five considers surgery of the abdomen, while Part Six concludes with surgery of the pelvic region. An author index and a subject index are complete at the end of each volume.

This is a well written piece of work—and it is not padded. Any graduate of medicine can follow a description of an operation step by step and have a very good idea of what it's about.

Surgical interns and residents, and young assistants to seasoned surgeons would do well to add these volumes to their libraries. They will refer to them constantly and with profit. Dr. Thorek tells us it is "intended particularly for students, for general surgeons and for those general practitioners who are occasionally called upon to perform emergency operations." He has followed his blueprint to the *n*th degree.

Dr. Donald C. Balfour has provided a short but superior foreword.

Dr. Thorek is to be commended and congratulated in completing this needed work, and in turning out such a finished workmanlike job. A bow is offered to the publishers also, for giving us three good looking volumes, well printed, and with illustrations excellently reproduced.

THE RELATION BETWEEN INJURY AND DISEASE. By Jewett V. Reed, B.S., M.D., F.A.C.S. and Charles P. Emerson, A.B., M.D., D.SC., with the collaboration of E. B. Mumford, B.S., M.D., F.A.C.S. Indianapolis, 1938. Bobbs-Merrill. Price $7.50.

This carefully and well written book fills an acute need at the present time. The authors frankly tell us it is intended for three professional groups: officials of insurance companies which carry the various types of casualty risks; lawyers who present, either pro or con, accident cases before courts and boards; and physicians and surgeons.

We are informed that "On the basis of so-called 'expert medical testimony' a new and strange pseudo-pathology has been slowly evolving in the Courts. . . . The responsibility for some, but by no means all, of the mistaken testimony of physicians in accident cases rests with medical textbook authors who 'round out' their paragraphs on the etiology of too many diseases by the words 'and injuries,' a statement which they have copied and recopied from their predecessors of several decades ago, although in the case of many diseases the progress of medicine has exposed this as an error. . . . Physicians responsible for the care of injured persons in whose condition there is the element of liability are impressed by the unfairness of many settlements made . . . many injured

persons receive little or nothing for physical disabilities and impairments justly compensable, while others receive awards for diseases not in the least due to injury."

The purpose of the book is to reduce the number of such injustices in both directions.

The book is 577 pages long and well indexed. The authors cover the subject adequately and have resorted to no padding. We venture that this work will find its way into many offices, including many not medical, and will be frequently quoted in courts.

A Textbook of Medical Bacteriology. By David L. Belding, M.D. and Alice T. Marston, PH.D. In collaboration with Sanford B. Hooker, M.D., Sidney C. Dalrymple, M.D., DIP. BACT., Jose P. Bill, M.D., P.H., and Matthew A. Derow, M.D. New York, 1938. D. Appleton-Century. Price $5.00.

This is a concise and yet comprehensive textbook of medical bacteriology, standing between the weighty reference books and the light simple texts. The book is purely and simply a teaching text. Only such recent advances as have proved their worth have been included.

Emphasis is placed upon the relationship of bacteriology to public health and preventive medicine. Immunity is presented as a distinct entity. Because of the increasing importance of the fungi and the ultramicroscopic viruses, a relatively greater amount of space than usual has been devoted to them.

The line drawings are purposely diagrammatic rather than photographic, and are the work, as are the other illustrations, of Mr. C. E. B. Bernard.

The book represents the coöperative work of the members of the departments of bacteriology, public health, and preventive medicine of the Boston University School of Medicine.

There are 549 pages of text, an appendix (including special methods of staining, formulae for culture media, and technical methods), two pages of supplementary references, a list of journals useful for reference, a glossary, and an index.

Plastic Surgery. By Arthur Joseph Barsky, M.D., D.D.S. Philadelphia, 1938. W. B. Saunders Co. Price $5.75.

This small book (355 pages) is a clinical evaluation of methods. The author tells us the work offers procedures which have proved successful in his hands and in the hands of other workers. The author has stuck to his guiding aim—to convey by word and by picture the principles and practice of modern plastic surgery.

Among the subjects considered we may mention: free skin grafts; flaps and tube pedicles; transplantation of tissues other than skin; treatment of wounds; burns and frostbite; scars and keloids; the orbit; the nose; the ear; harelip and cleft palate; lips, cheeks and jaws; fractures of facial bones; the neck and trunk; orthopedic aspects of plastic surgery; the extremities; and prostheses.

The illustrations, mostly line drawings, are very good. There is a bibliography at the end of each chapter. The author has an easy style in writing and holds the attention of the reader.

The surgeon who intends doing more or less plastic (we hear it's now called "construction") surgery will do well to consider studying Dr. Barsky's text.

Cancer—Its Diagnosis and Treatment. By Max Cutler, M.D. and Franz Buschke, M.D. Assisted by Simeon T. Cantril, M.D. Philadelphia, 1938. W. B. Saunders Company. Price $10.00.

We read in the preface of this splendid book, "The special purpose of this work is to make accessible to the reader a critical evaluation of the pertinent facts in the diagnosis, prognosis and treatment of cancer as gleaned from the world literature and reviewed in the light of our own experience." The authors tell us they have left to existing treatises the presentation of such highly specialized forms of cancer as those of the central nervous system (Harvey Cushing and Loyal Davis). Also, that only those aspects of pathology are discussed which appear to have a direct bearing upon the clinical management of the disease. Questions of histogenesis and detailed morphology have been left to other works (Ewing).

The authors realize that the important thing is the early detection and diagnosis of cancer. Therefore the work is addressed to the general practitioner as well as the specialist.

This book (757 pages), is interesting and instructive reading. The illustrations are espe-

cially good. An extensive bibliography is included, as are author and subject indexes.

LES ULTRAVIRUS DES MALADIES HUMAINES. By C. Levaditi and P. Lépine. Volumes I and II. Paris, 1938. Maloine.

Our knowledge concerning the ultraviruses and the human diseases they cause is progressing so rapidly that it is impossible for one individual to assimilate it all and to separate what has been firmly established from what is as yet unproved. For this reason the authors have considered it useful to publish a work in which each subject is treated by an author who has made individual contributions and who has the perspective necessary to separate fundamental facts from those that should be kept in the background.

They have produced a work that is authoritative and well documented and yet does not pretend to be an encyclopedia. Those virus diseases about which our knowledge is still uncertain have been omitted. The authors have tried to bring to the reader, whether he be a clinician or man of the laboratory, a view of the whole subject and at the same time to place at his disposal the more important source material. The book is an excellent piece of work and represents the best that comes from French science today. It belongs in the library of every man seriously interested in the virus diseases.

SENSIBLE DIETING. By William Engel, M.D. New York, 1939. Alfred A. Knopf. Price $2.50.

We have, in our time, read many books on diets and dieting, some fair and many terrible. Too often they are written by food cranks who have never heard of the science of physiology. It is therefore with considerable relief and pleasure that we picked up Dr. Engel's sound and conservative book. We chuckled in some parts, but learned many things for the first time, and continually marvelled at the author's ability to pack so much in a minimum of words.

This book gives ample evidence of having been written by a physician who knows and believes in proved scientific facts, and who has only ridicule and disgust for the thousand and one food fads which have assailed us during the past two decades. He disposes neatly of commercial food advertising, of claims for creams which "melt fat," for bath salts which "reduce," and for massage which can "take it off" here and there. One discovers why exercise is a poor reducer.

Not the least remarkable feature of the book is the 300-page section devoted to actual menus, suitable to the various seasons and yielding varying caloric contents. There is a series of daily menus, covering a week's time, each day's food allotment producing 1,000 calories. Other series step the caloric yield up, with gradual increases to 2,000 calories.

The common sense which rules throughout makes this book profitable both to physicians and to laymen. It is just the thing to suggest to a patient who has requested a diet to rid him of 20 to 40 pounds of excess weight.

FUNDAMENTALS OF INTERNAL MEDICINE. By Wallace Mason Yater, M.D. New York, 1938. D. Appleton-Century Company. Price $9.00.

Dr. Yater tells us his volume "is designed primarily for the introduction of students to the subject of internal medicine, [and] is intended to provide the foundation upon which the superstructure of more detailed and extensive knowledge may be built." Fractures, dislocations, obstetrics and strictly gynecologic diseases are excluded. Otolaryngology, ophthalmology and dermatology are included only for the information that an internist or general practitioner should possess. Only rotational therapy of proved value has been included, and tables of differential diagnosis have been prepared to simplify the subject.

The author has called to his assistance several of his associates in the preparation of certain sections of the book. The whole is 1,021 pages long, with 255 illustrations, and an ample index.

It is a good book, recommended without reservations to general practitioners and internists.

THE PHYSIOLOGY OF ANESTHESIA. By Henry K. Beecher, M.D. New York, 1938. Oxford University Press. Price $3.75.

Any one interested in the subject of anesthesia, whether he be an anesthetist, a surgeon or a technician nurse giving anesthesia can well read this book with profit. The author says that the material he presents was originally used in teaching the fundamentals of anesthesia to the Harvard medical students. His plan of presen-

tation is to describe the response of the body to anesthetic agents and to anesthesia.

The following broad topics are considered in more or less detail: effects of anesthesia on the nervous system; respiration and anesthesia; circulation and anesthesia; and organic effects of anesthetic.

This book of 388 pages is well written, has the ring of authenticity, and leaves little or no room for criticism. It has an extensive bibliography and an ample index.

Cabot's Physical Diagnosis. By Richard C. Cabot, M.D. and F. Dennette Adams, M.D. 12th Edition. Baltimore, 1938. William Wood & Co. Price $5.00.

Over thirty years ago we used Cabot's "Physical Diagnosis" as our textbook—it was born thirty-eight years ago. The new twelfth edition is still covering this important subject scientifically and interestingly.

The present edition has been completely rewritten on a new basis that recognizes the progress of present day physical diagnosis.

This standard text (standard in every sense of the word) is 846 pages long, has 391 illustrations, and an ample index.

The book is beyond praise. It will continue to be the first choice of teachers, should be owned by every student of medicine, and is a "best buy" for the up-to-date old grad. A lot of book, all solid gold, for very little.

The Surgery of Oral and Facial Diseases and Malformations: Their Diagnosis and Treatment. By George Van Ingen Brown, M.D., D.D.S., F.A.C.S. 4th Edition. Philadelphia, 1938. Lea and Febiger. Price $10.00.

We are offered the fourth edition of this popular work, a standard text designed for students, but at the same time a reliable source of reference for practitioners of medicine. The importance of plastic surgical reconstruction has made it necessary to detail what can be accomplished by surgery in this field. The author has included drawings of the operative steps employed in such surgical procedures, and gives the reasons for their selection.

This book is 778 pages long, has been thoroughly revised, and has 1,019 illustrations, 12 colored plates, and an index. It can be rated A-1.

Classic Descriptions of Disease. By Ralph H. Major, M.D. 2nd Edition. Springfield, 1939. Charles C. Thomas. Price $5.50.

Dr. Major's work is an ideal gift for a medical friend. If you yourself do not own a copy, we hint that you buy one. Many hours of satisfying reading await you, since this is manifestly the book to turn to when the work-day has ended. You can open it at random and start to read.

There are 403 selections from the original epoch-making accounts of 190 authorities, whose contributions and discoveries provided the foundations of modern clinical medicine. The entire field of medicine and its development from the the author of the Papyrus Ebers to discoveries of modern times is covered.

This beautifully printed book of 727 pages has 137 illustrations and 993 index references. This second edition includes much new material.

The Treatment of Fractures. By Charles Locke Scudder, M.D., F.A.C.S. 11th Edition, Revised. Philadelphia, 1938. W. B. Saunders Company. Price $12.00.

The first edition of this book appeared in 1901, and from that time until 1926, ten editions were published. During the past twelve years many new advances in the diagnosis and treatment of fractures have made "it necessary, in order to meet these new conditions and to include all these many advances, to rewrite the book completely." All obsolete methods have been omitted and new methods of treatment and diagnosis have been added.

For the presentation of special fracture problems the author has turned to men actively engaged day after day in handling these problems. It would add to the worth of many books if this method was followed more often.

The general surgeon and the general practitioner are given clear and clean cut guidance in meeting fracture problems. First aid is emphasized. Since the general practitioner is usually the first to see a fracture the first aid underlying principles are important if one is to get full restoration of function.

This book of 1,208 pages, has 1,717 illustrations, many of them new, appearing for the first time in this edition. The index covers twenty-three pages.

A book which has lived for three or more decades and has gone into over ten editions needs no further favorable comment.

THE ESSENTIALS OF MODERN SURGERY. Edited by R. M. Hadfield-Jones and A. E. Porritt. Baltimore, 1938. William Wood and Co. Price $9.00

The editors of this book felt that there was a real need for yet another textbook of surgery. Most books are either tomes of two or more volumes or else handbooks of small size. Between these, the editors felt, there was room "for a single textbook in which surgical teaching is based on the fundamental principles of anatomy, physiology and pathology." The editors' object has been to provide students and practitioners with the essentials of modern surgery in concise form in a book which would be "of practical use to students studying for the higher examinations." Thirteen colleagues have coöperated with the editors in compilation.

The reviewer agrees with the editors that such a book has no space for the details of operative treatment. No details of technique have been included except in a few instances. The volume contains 1,126 pages, has 501 illustrations and an index.

SPECIAL ARTICLE

The Evaluation of Surgical Procedures on Bones, Muscles and Peripheral Nerves in Spastic Paralysis

BY

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AND

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THE EVALUATION OF SURGICAL PROCEDURES ON BONES, MUSCLES AND PERIPHERAL NERVES IN SPASTIC PARALYSIS*

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NEW YORK CITY

INTRODUCTION

THE problem of treating children afflicted with cerebrospinal spastic paralysis has always been a bewildering one, presenting in its literature only a conflicting mass of material. The subject has been approached from many different points of view, but there has been no analysis of the result of the massive amount of research, experiment and actual treatment.

Surgery has always been the foremost element in the treatment of spastics, and much of it has been done that has been helpful, much harmful. It seems that few surgeons have a thorough knowledge of the worth of some of the existing surgery. As a whole, postoperative study in surgery of spastic paralysis has been neglected.

In order to accomplish this, an attempt has been made to review the cases in the Hospital for Ruptured and Crippled which have undergone operation, and to evaluate clearly and definitely their results. Nothing is herein to be considered original. As in any review of the literature of such a large subject, many things may be overlooked, and due apology is made to the authors at this time.

HISTORY

In the year 1843, William J. Little, in his course of lectures on the deformities of the human frame, discussed a spasmodic affection which he thought was produced at the moment of birth, or within a few hours or days of that event. He felt that this was due either to prematurity, the difficulty and slowness of parturition causing asphyxia, or to the deteriorated health of the parent impairing the normalcy of the fetus.

This heretofore unknown entity thus obtained its name, and Little's Disease has continued to be a problem to the obstetrician, the family physician, the neurologist, the surgeon, the parents, as well as to the patient himself.

Little continued to investigate this condition throughout his life and again elaborated its description in 1853. In 1862 he wrote a complete article, at which time he stated that in his private practice he had treated over 200 cases traceable to causes operative at birth and propounded the theory some abnormal act connected with the mode of birth was the cause. He attempted to treat these cases armed only with tenotomies to release rigidity and spasticity, the practice of which he and Stromeyer were the first advocates.

This was the situation until Foerster in 1908, with his theories of the mechanism of the reflex arc and spasticity, advised a section of the posterior spinal roots which supplied the affected extremities. He presented excellent results which were confirmed by his associates and others.

* This work has been made possible through a grant from Child Neurology Research, Friedsam Foundation, New York City.

However, this procedure soon passed into the background and not many who were treating those patients took to it.

An entirely new concept was brought forth in 1924 by Hunter and Royle, who described an operation of sympathetic

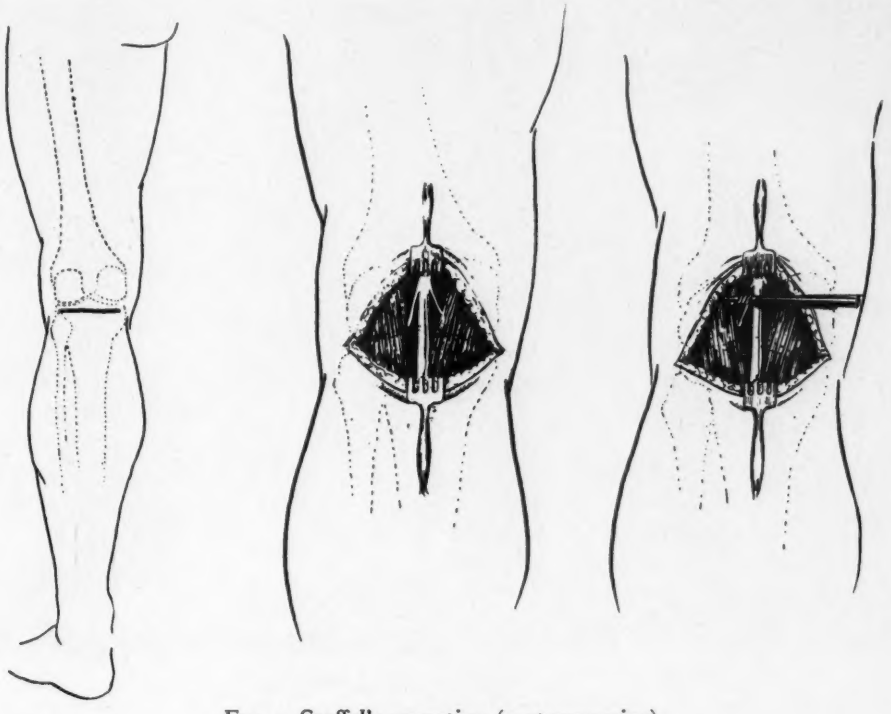


Fig. 1. Stoffel's operation (gastrocnemius).

In 1912, Stoffel brought forth his principles of treatment which have continued to be, up to and including the present time, the most significant in the care of spastics. Not only has his work been proved by his results, but it has been universally confirmed. Stoffel did not offer a cure for spasticity, but so improved these patients' functions and capabilities that they were able to take their places as useful members of society, able to look after themselves.

In 1915, Sharpe and Farrell stated that, after considerable study concerning the mechanism of labor in childbirth, the condition of the infant at birth, the signs presented and the progress in childhood, they felt that a very large percentage of these cases were due to increased intracranial pressure caused by hemorrhage or trauma. They recommended as the appropriate treatment cranial decompression, and reported evidence of improvement following operation, as well as the findings at operation.

ramisection and provided an experimental basis for it.

A few years ago, Phelps began to classify these patients as to types. It became clear, then, that the treatment of each case had to be absolutely dependent upon the type of patient, one treatment differing from another. He brought out very definitely the fact that thorough study of each patient was necessary and that rehabilitation could be obtained by muscle reëducation and training.

At the present time, Putnam is, by neurosurgical experiment on the extrapyramidal tracts, showing that a tremendous improvement can be made in the control of athetosis.

ETIOLOGY

Cerebrospinal spastic paralysis in orthopedic practice is second in frequency and importance only to anterior poliomyelitis. Much has been done in the investigation into the cause of the condition.

Sachs has suggested probably the simplest classification regarding the time of occurrence: antenatal, natal and postnatal.

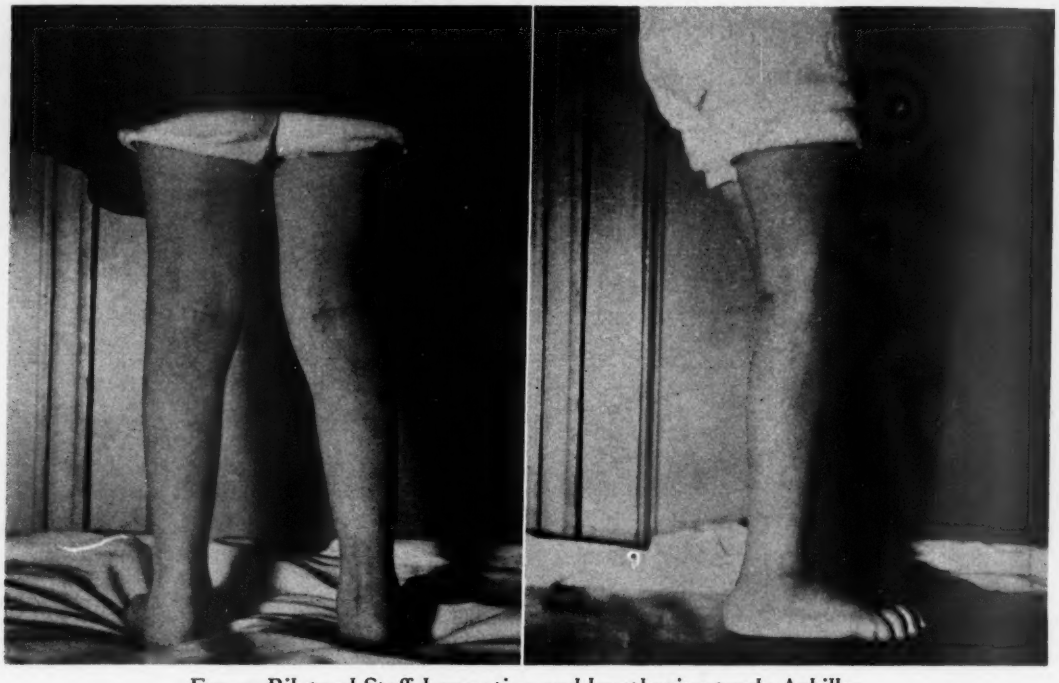


Fig. 2. Bilateral Stoffel operation and lengthening tendo Achilles.

It is not always an easy task to determine the etiology in the individual case, as so many come under observation late, when the signs have lost their intrinsic identities and have taken on similarities.

The cerebral lesions having their origin in utero, or antenatally, depend primarily on conditions affecting the mother secondarily on the fetus or its maldevelopment.

In the natal group are those palsies dependent on intracranial hemorrhage, which is either the result of trauma to the infant's head during a precipitate labor, prolonged labor, forceps delivery, breech delivery, or possibly the result of prolonged asphyxia at birth.

In addition to the cranial injuries, definite evidence of spinal cord injury has been reported by Studdiford, and references have been made to this type of injury by Crothers.

In the postnatal group, we have the statement by Butler that spasticity coming on in childhood may be caused in one of three ways: first, vascular lesions, such as hemorrhage from venous or arterial rupture, as the result of trauma or as a spontaneous occurrence in intense congestions such as convulsions, paroxysms of whooping cough, embolism from cardiac or arterial thrombi, endocarditis, occasionally in endarteritis and thrombosis; second, spasticity may be caused by inflammatory changes such as acute encephalitis, meningo-encephalitis, and polioencephalitis; third, it may be caused by brain tumor, which can be usually differentiated by progressive signs and symptoms.

PHYSIOLOGY AND PATHOLOGY

The study of the nervous system suggests at once its functional place in the human body. The vast connections of this system with all parts of the body indicate the possible channels through which information is received of the state of environment, and of the condition of the different organs engaged in carrying on the processes of life. Fashioned together as one structure, intimately connected and related in all its parts, the brain and spinal cord serve admirably the function of directing, coördinating and controlling the activities

of the body. The nerves of the system are merely the pathways by which messages are brought to the central station, the brain, and directions are sent out to the outlying agents that will put into effect the orders received. Thus the movements of muscles are under the supervision of this structure, the nervous system.

If the highly organized central nervous system is to have a broad field of endeavor worthy of its powers, locomotion must be easy and rapid and all segments of the nervous system must work in exact coördination. Anything disrupting any part will lead to difficult uncontrollable locomotion.

The cord is responsible for the simple reflex motor act. It is also made up of ascending and descending tracts which relay these impulses to the centres higher up in the brain stem, basal ganglia, and cerebral cortex.

As long as the reflex arc is dominated by these higher centers, there is a braced up condition in the muscles, which is called reflex tonus. This tonus is the basis of all postural reactions.

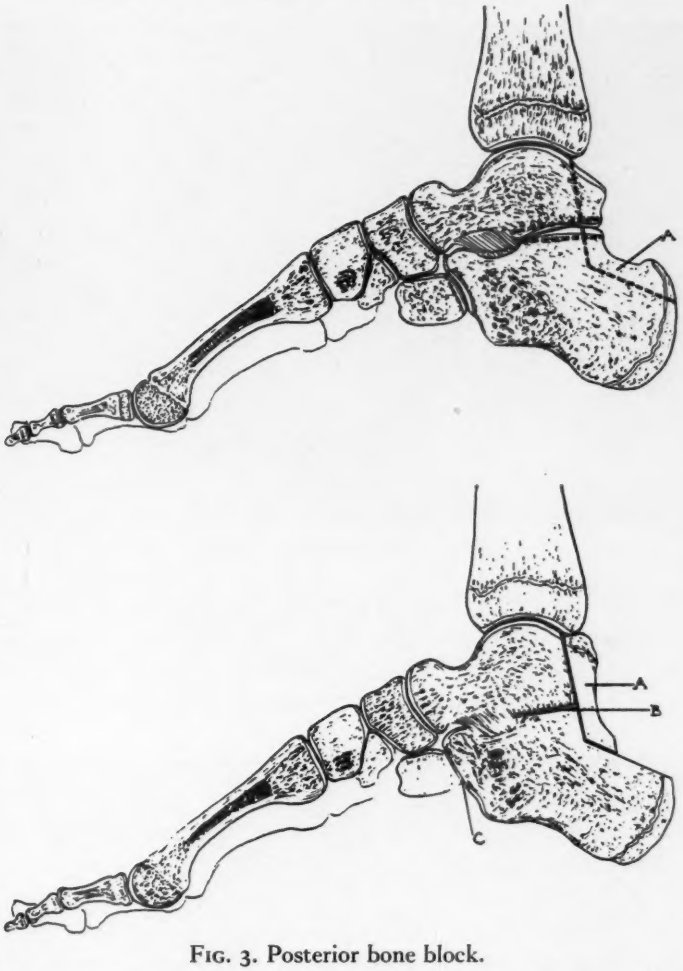


Fig. 3. Posterior bone block.

It is generally believed that all muscle tonus is controlled in the high centers. There apparently is a state of inhibition affecting muscles, which prevents the reflexes from acting continuously at their strongest force; it also prevents complete relaxation affected in agonists and antagonists. Just where this inhibition is effective, no one is sure, but it is felt that it does take place in the upper nervous system.

It can easily be seen that any disturbance in the corticospinal system would lead to abnormality in tonus, coördination or control. And, as this system is upper motor in type, spasticity will result unless the damage is without the direct tracts

such as in the lenticular or cerebellar region, in which case disturbance of coördination and balance will take place.

and so forth, are incompatible with life, but other types of agenesis or lagging development and growth may occur. Fre-

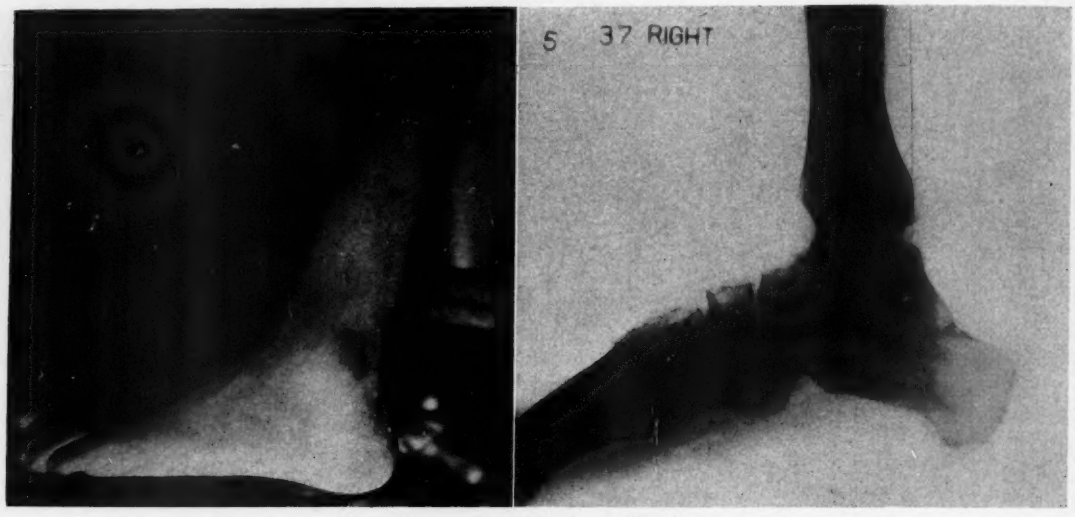


Fig. 4. Posterior bone block.

Just what these lesions are pathologically calls forth considerable disagreement. Cases which have come to autopsy have varied. This, of course, is to be expected because

quently this lack of development may lead to spasticity of the diplegic type with mental deficiency. Microscopic examination in cases of this group at times shows

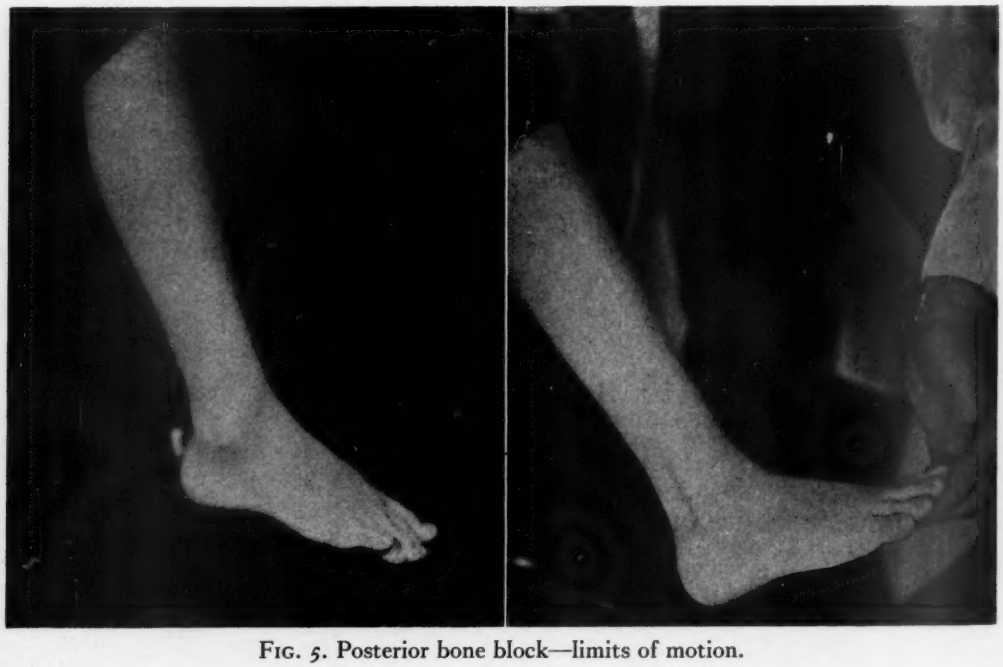


Fig. 5. Posterior bone block—limits of motion.

of the difference in etiology. The anomalies no doubt cause a large percentage of the prenatal group. The gross types, such as anencephaly, iniencephaly, notencephaly,

no pathologic lesions whatsoever, but occasionally may show a disarrangement of the normal pattern. At times, large, degenerative or cystic areas, porencephaly, are

found. Collier concluded that it was a primary neurogenic degeneration.

In the natal or birth injury group, the pathology is more definite. If a lumbar puncture was done routinely on newborn infants, one would find a rather large percentage of bloody taps. No doubt the incidence of cranial damage is much greater than one would think, but usually it is so slight, no evidence is seen and the children progress normally.

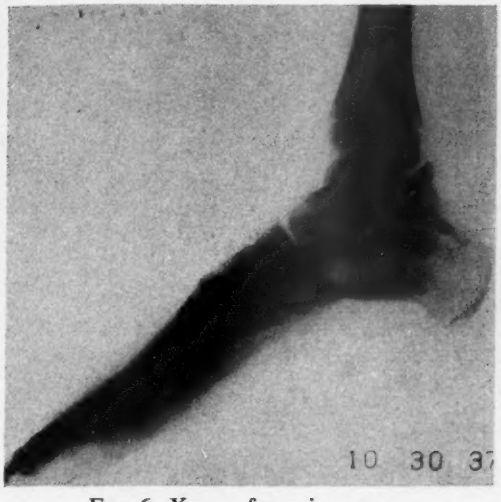


Fig. 6. *X*-ray of previous case.

In the cord, the pathology ranges from merely perivascular hemorrhages and stretching of tissue to marked hematoma and complete rupture of the cord. The late lesions show fibrosis and degeneration of the cord.

In the postnatal group, injuries causing hemorrhage may present the same findings as in the birth injury group. Syphilis may cause late development of spasticity due to rupture of weakened vessels, or the condition may cause adhesions between the dura and pia-arachnoid. Often in late cases, there are seen cellular foci or granulomas with necrosis of normal cell tissue. Occasionally vessels are obstructed and local encephalomalacia occurs.

In the cases occurring after scarlet fever and measles no doubt acute serous meningitis was present. This is an affection of the pia-arachnoid, often of the cortex, characterized by congestive hyperemia, edema and the production of an exudate.

In the various purulent meningitides, permanent damage may be done to the membranes and even the cortex. Degeneration of the involved tissues results in scarring or pulling by adhesion to produce disturbance in the normal mechanism of the cerebrospinal nervous system.

When spasticity follows encephalitis, the pathology is about the same, the type

Fig. 7. Bilateral posterior bone block.

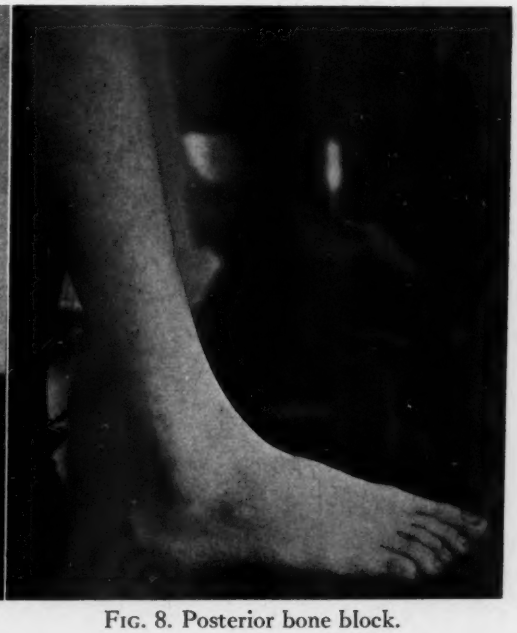


Fig. 8. Posterior bone block.

depending upon where the greatest process has taken place. It may be of a cortical type, called meningo-encephalitis, or it may be in the grey matter, called polio-encephalitis. Microscopically, there is a destruction of cells with the formation of sclerosed areas or fibrous scar.

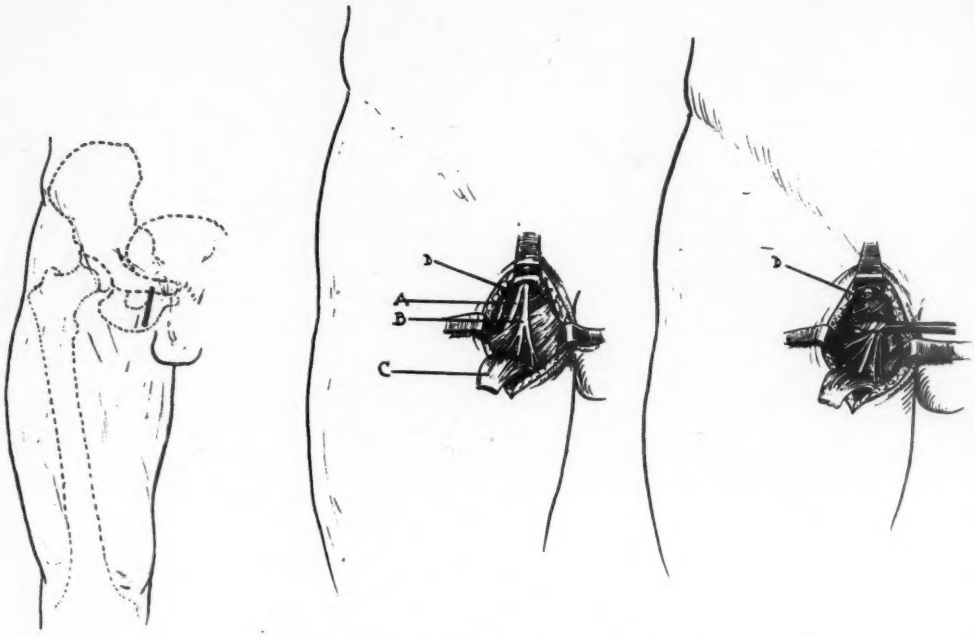


Fig. 9. Stoffel operation of obturator nerve.

After these children grow older, the pathology is not differential. One can find approximately the location of the lesion, but one cannot definitely say whether it is of prenatal, natal or postnatal origin. Therefore, the history is of great importance, and the treatment must be guided by the status of the individual.

SURGICAL DISABILITIES

As stated by Phelps, this type of patient has always been considered from a neurologic standpoint. The various lesions have been described, but not much has been offered to correct them. Therefore, one must consider this problem from its disabilities.

Spasticity is the most common disability. There is hypersensitivity of muscles to any stimulus they may receive, whether they be from within the body or without. Any motor action of a muscle is increased, and also is counteracted by its antagonists.

Athetosis, which is seen about as frequently as spacticity, is the next disability. This manifests itself by constant contractions of successive muscle outside the control of the patient. It varies in intensity and does not seem to be affected by voluntary contraction. One will notice these patients when at rest constantly moving.

Now we come to the deformities which may result from imbalance of muscles. In cases of spasticity, the limbs seem to assume an atavistic position. Groups of flexors constantly spastic will outdo the antagonists and, though the latter are spastic too, in most instances they become elongated or weakened. For instance, the knee is a good example. The hamstrings are so much stronger than the quadriceps that the latter does not seem to have the ability voluntarily to extend the knee completely. Very often the patella is found very much higher than normal when the knee is passively extended. These joints, if they have been allowed to remain in abnormal positions any length of time,

will lead to structural changes. That is, there may be capsular and ligamentous contractures and the predominant muscles will contract. The deformities frequently seen are torticollis, adduction and internal rotation of the shoulder, flexion of the elbow, pronation of the forearm, flexion of the wrist and fingers, also adduction of the latter. In the lower extremity, adduction and flexion of the hip, flexion of the knees, flexion of the ankle, and deformity of the foot and toes are often present.

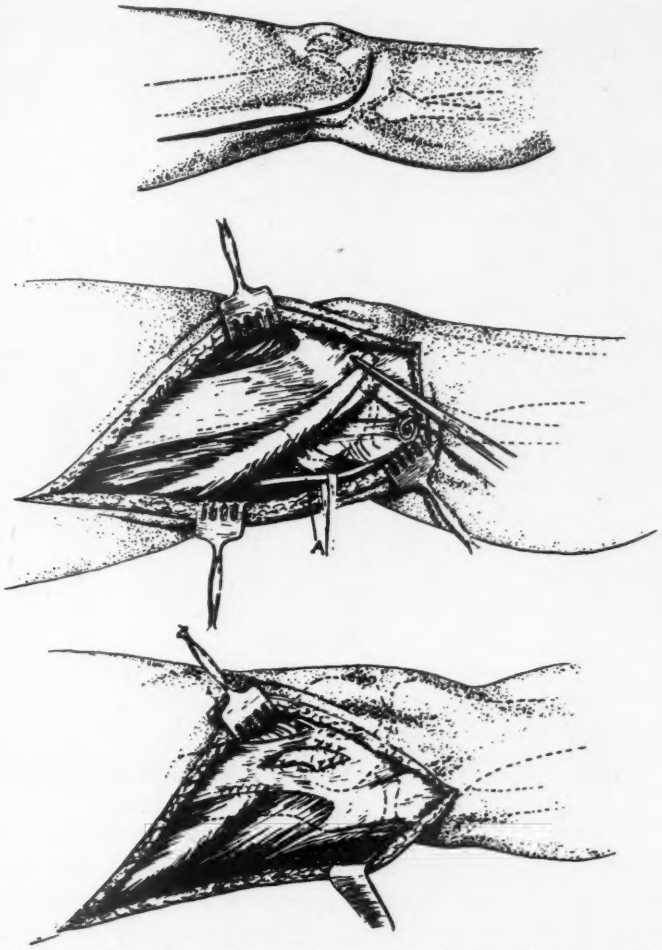


Fig. 10. Transplantation of biceps femoris muscle to patella.

TREATMENT

Writers for many years have spoken of the value of training spastics, but it was not until Phelps began classifying the types and giving individual training to each that much was thought of this method of treatment. Phelps feels that a diagnosis should be made first to determine whether the condition is progressive or not. The mental status, too, was found to be of great importance, for, if a child is mentally deficient, it is useless to attempt reëducation, or even to attempt surgery unless it is to improve him for home care.

In mild cases, muscle reëducation, if properly administered, will give almost a perfect result. In the more severe cases, it is variable. We are aware that it takes years to accomplish this work.

The normal child habitually begins school at about the age of 6, but many spastic children never have any education whatever. The result has been that these patients have been doomed as mentally deficient. However, like normal children, they are entitled to education. If special classes cannot be formed for them, indi-

vidual training should be given by tutors or parents. A large number can be accommodated in the regular schools.

advocate it in cases of athetosis, but only in selected cases of extreme spasticity.

The patients were relieved of their

Figs. 11 and 12. Bilateral biceps transplant.

Speech difficulty is one of the most common disabilities of spastic and athetoid children. Along with their other treatment, they should have training of this type also.

There is no doubt that muscle training plays a very important part in the rehabilitation of these patients and many are almost completely relieved by its application, but there are others who are very severely affected with whom nothing can be accomplished. It is these cases which have led physicians to seek other methods of treatment of a surgical nature.

In 1908 Foerster published his theories of spastic paralysis. He did a laminectomy to cut the posterior roots. The sensory impulses were reduced and the spastic symptoms diminished. He felt that as long as the muscles were spastic because of involuntary sensory excitation, they could be relieved by this procedure. He did not external spasticity but their structural deformities, if they had developed, still remained. All of his patients had an extensive course of muscle training afterward, along with orthopedic corrections when necessary.

This work was confirmed by Clark and Taylor who stated that there was tremendous improvement, with no significant sensory disturbance afterward. Also Hey Groves, Blahd, and Frazier reported good cases.

It is important to notice that all writers advocated this procedure only in very severe cases of spasticity and that, following the operation, many were left flaccid, but in time regained their reflexes. This may explain why the procedure has not become more popular. It is probable that patients continued to regain muscle tone to the extent of becoming spastic.

In 1912, Stoffel wrote about an operation which he developed to reduce the spasticity of the individual muscles. He agreed with Foerster regarding the phsyiology of the condition. In his investigations, he found that each muscle could be divided into several sections and that they, in turn, could be subdivided. In other words, each group of 100 to 200 muscle fibers was innervated by one nerve fiber. The stimulation of one gave a twitch and all gave a muscle contracture. He stated also that functions of the joint were carried out not by a single muscle but usually by groups of muscles.

Therefore, he believed that, by cutting part of the nerve funiculi in a motor nerve, the same effect could be produced that is produced in a muscle in anterior poliomyelitis. Part of the muscle would be paralyzed. In groups of muscles, part of the group could be paralyzed by cutting the entire innervation of the muscle. He advocated that this be done near the point of entrance of the nerve to the muscle, as in the case of the gastrocnemius. When this is impossible, such as in the case of the flexors of the legs, the procedure was to split the muscle nerves into its component parts higher up at an easily accessible place, and cut some of the fibers to the muscles to be weakened. If, for example, the operator wishes to weaken the pronator teres, the median nerve is exposed at the lower arm. After separation of the branches, they are touched with a needle electrode to determine the proper branch.

Stoffel stated that the postoperative treatment was important. Training of the patient should be begun as soon as the wounds are healed. The result was not often immediate, but appeared only after reëducation. He also stressed the fact that one should be careful not to paralyze too much muscle as the antagonists could very easily produce the opposite deformity.

This work has been confirmed by Dickson, Gill, Heyman, Ryerson and others.

Not long after the advent of peripheral nerve surgery for the relief of spasticity, Sharpe and Farrell, and later Sharpe alone, stressed the importance of intracranial hemorrhage in the newborn. Previously, it had been considered a chronic condition and only the end result was considered. They felt that the diagnosis should be made earlier and decompression done to relieve the pressure, so that further damage to the brain might be prevented. Early lumbar puncture in doubtful cases would determine the presence of blood in the spinal fluid. Repeated punctures were recommended to relieve the pressure at first, later to be followed by operation if improvement were not permanent. Many cases of subdural, supracortical and subarachnoid hemorrhage were found at operation. In the more chronic cases, operation was advised when signs of increased intracranial pressure were found. The eye changes seen were described by Kearney.

Fig. 13. Bilateral biceps transplant—incomplete extension.

This work was carried on for many years with repeated good reports. Lately von Briesen stated that neurosurgical treat-

ment by craniotomy or spinal drainage in cases of localized meningeal hemorrhage at birth may prevent subsequent brain damage. He also stated that the late neurosurgical treatment after pathology has become static is beneficial only to a limited degree, the benefit being most marked in cases which at operation had corticodural adhesions.

The work of Hunter and Royle, which came upon the world as a cure for spasticity, was only short lived, even though many good results were reported. It was their contention that spastic paralysis could be relieved by destruction of the sympathetic innervation to the affected muscles. They offered experiments to substantiate their views and reported cases.

A

B

Fig. 14. Biceps transplant.

No doubt there was improvement in the patients, as this was confirmed by Stewart, von Lackum, and Carrell. It was felt that this procedure would reduce the plastic tone and was indicated in only those cases which had it.

Kanavel and associates would not confirm the work as by experiment they could not prove its value. They felt there might be some effect on muscle tone by a vasomotor or chemical change.

As stated by Phelps, there were certain cases of athetosis which would not respond to any type of conservative treatment. The operations mentioned have all been indicated, if at all, only in cases of spasticity. Athetosis, as mentioned before, is due to pathology in the lenticular region and its connection with the muscles is the extrapyramidal tracts.

Putnam has been doing a section of the extrapyramidal tracts. In twenty cases of athetoid syndrome, an operation was carried out, consisting of section of the anterior quadrant of the cord above the brachial enlargement on one or both sides as indicated. In addition, section of the first three anterior roots and the spinal accessory nerves was performed in cases in which torticollis was a prominent symptom. Two patients in the series died after operation from causes which he feels should be avoidable in the future. All the rest showed improvement with the exception of two. This work has also been started by Eric Oldberg of Chicago, whose cases show improvement. The above is encouraging and no doubt will offer some relief for those severe cases which have been so much of a problem in the past.

From what has been said before concerning the treatment from a surgical standpoint, there does not seem to be any one procedure or type of procedure which will answer for the cure or improvement of these cases. Therefore, it is the feeling that we still must consider each patient as an individual problem.

Such has been the situation at the Hospital for Ruptured and Crippled. Training either at the hospital by physiotherapists or at home has been advised to nearly all, accompanied by surgical procedures for

Fig. 15. Biceps transplant—incomplete extension.

the relief of spasticity or correction of deformity when it seemed necessary.

From 1926 to 1937, 1831 cases of cerebrospinal spastic paralysis were seen in the out-patient department of the hospital.

Chart 1

CEREBROSPINAL SPASTIC PARALYSIS

Hospital for Ruptured and Crippled

		Cases
1926 to 1937	Seen in O. P. D.	1831
1926 to 1937	Admitted to hospital	380
End result study	Operative	210
Operations		
Equinus deformity of foot		209
Adduction deformity of leg		123
Flexion deformity of knee		81
Other deformities of foot		49
Flexion deformity of wrist		49
Pronation deformity of forearm		4
Deformities of the hand		3
Spasm of the neck		1
Deformities of the hip		17
Deformities of the toes		10
Sympathetic ramisection		8
Total		554

Three hundred eighty cases were referred into the hospital for operation. In a recent review, it was possible to obtain an end result evaluation in 210 cases on whom 554 operations were done. (Chart I.)

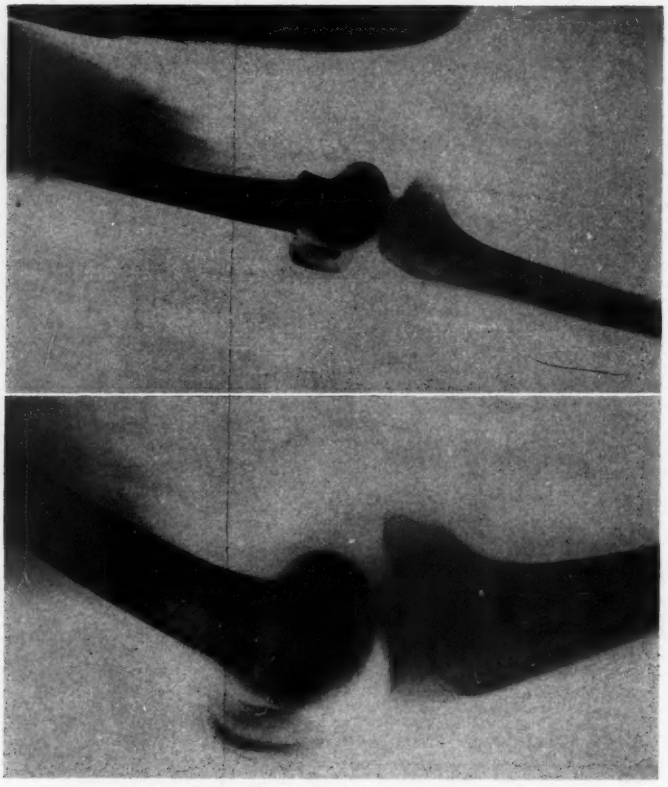


Fig. 16. Fixed flexion and supracondylar osteotomy.

Chart II
EQUINUS DEFORMITY OF FOOT

	Operations	Good	Fair	Poor
Stretching of tendon of Achilles	31	1	4	26
Lengthening of tendon of Achilles	92	28	17	47
Resection of nerves to gastrocnemius	37	28	3	6
Resection of nerves to gastrocnemius and lengthening of tendon of Achilles	17	16	0	1
Posterior bone block (Wagner)	32	28	3	1
Total	209			

For equinus deformity of the foot, there were 209 operations. (Chart II.) It will be noted that stretching of the tendo Achilles was unsuccessful. It is logical that recurrence of the deformity would take place because the influence has not been altered. In lengthening of the tendo Achilles, the same situation exists unless the tendon is lengthened sufficiently to weaken the muscle by atrophy of disuse. Over half have recurred and, of these, eight cases of calcaneous deformity developed from too great lengthening. This procedure is indicated when there is contracture but is best accompanied by Stoffel operation on nerves to gastrocnemius. The procedure now used is a 2 inch transverse incision (Figs. 1 and 2) made in the popliteal space at the level of the knee joint. The fascia is split longitudinally and the tibial nerve isolated. The medial sural cutaneal nerve is the first branch encountered posteriorly. Just below and to each side of this will be seen the branches to the heads of the gastrocnemius. These are cut and avulsed. The wound is closed anatomically.

In cases of severe spastic equinus or when there has been recurrence after nerve resection, a posterior bone block seems to be the ideal operation. There were thirty-two cases of the Wagner type (Figs. 3 to 8), with only one failure, being in a child of 6 years where absorption of the bone block occurred.

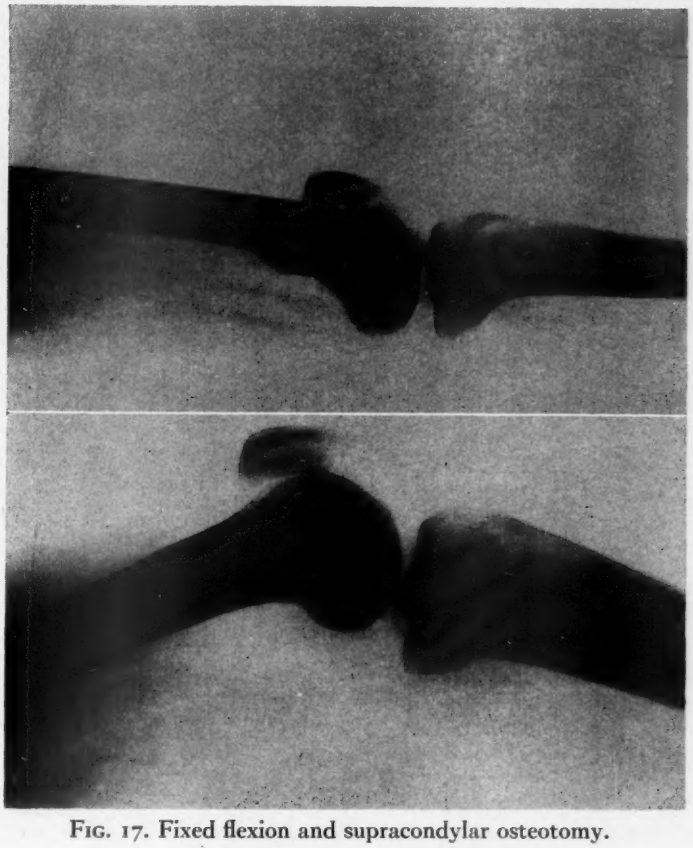


Fig. 17. Fixed flexion and supracondylar osteotomy.

Chart III
ADDUCTION DEFORMITY OF LEG

	Operations	Good	Fair	Poor
Resection of obturator nerve and adductor longus tenotomy	108	87	7	14
Adductor longus and brevis tenotomy	6	0	2	4
Stripping of all adductors	2	2	0	0
Stretching of adductors and application of plaster spica	7	0	2	5
Total	123			

For adduction of the hip, there were 123 operations. (Chart III.) When the obturator nerve was resected with tenotomy of the adductor longus muscle, the majority were successful. Here again, it should be noticed that stretching is unsound. The usual procedure of obturator nerve resection is a 2 inch incision, starting at the pubis, lateral to the adductor longus, or a transverse incision a thumb's breadth below the pubis. The fascia is incised longitudinally, exposing the tendon of the adductor longus. The latter is cut at its attachment and allowed to contract. By blunt dissection, the lateral border of the adductor brevis is located. At this point, the branches of the anterior ramus will be found. These are clamped and cut. By blunt dissection, this is followed upward to the obturator foramen. Usually, the posterior ramus will be encountered leading from it, going posterior to the adductor brevis. If not, it may be found slightly deeper piercing the obturator externus. The distal por-

tions may be avulsed and the wound closed anatomically. Plaster spicas are applied with the legs in abduction.

unusually high, the Chandler operation was done (Fig. 18), all of which gave a good result.

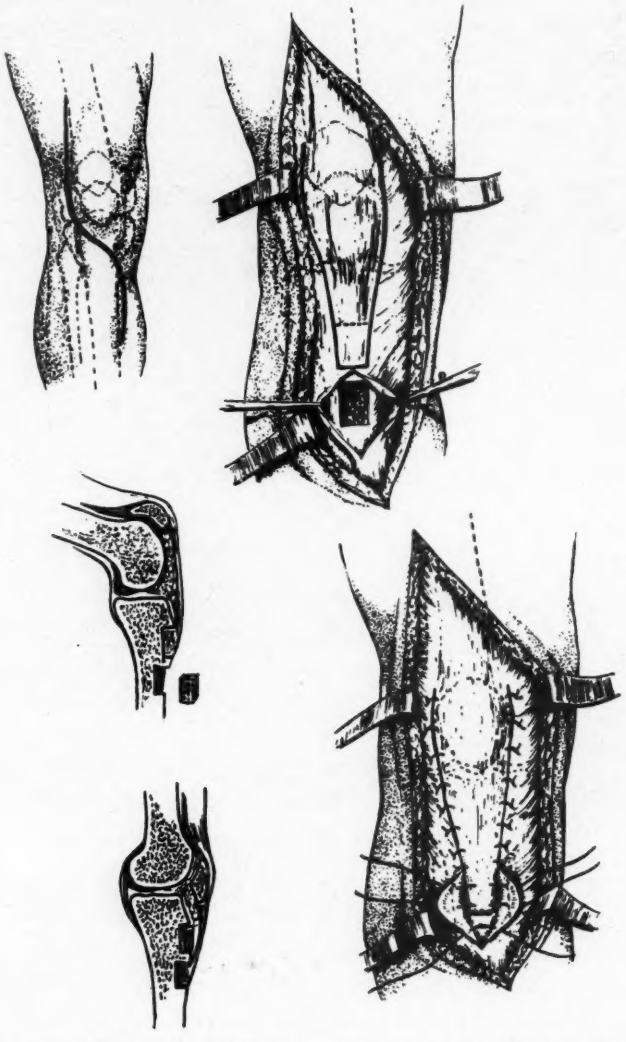


Fig. 18. Chandler operation—transplant of tibial tuberosity.

In cases of flexion deformity of the knee, there were eighty-one operations. (Chart iv.) The most common was biceps transplant to the patella. The majority of these improved the patients, but most were still unable completely to extend the knee by active power. When there was a fixed deformity of the knee which could not be easily corrected by stretching, a supracondylar osteotomy was the most effective and simplest manner of correction. Stretching of the knee alone was again a failure, as the imbalance still persisted. In a few cases, where it seemed the patella was

For deformities of the foot (Chart v), it will be noticed that correction by bony operation was the most successful operation, although correction of imbalance by transplantation of the anterior tibial tendon to the outer foot for varus gave good results. For the correction of calcaneus following lengthening of tendon of Achilles, astragalectomy gave surprisingly good correction.

Flexion deformity of the wrist (Chart vi) has been mainly corrected by attempting to regain muscle balance and that by means of transplanting flexor muscles to

the extensors of the wrist and fingers. (Fig. 24.) The majority of these improved

Chart IV
FLEXION DEFORMITY OF THE KNEE

	Operations	Good	Fair	Poor
Biceps transplant to patella	35	7	22	6
Semitendinosus to patella	4	1	1	2
Semitendinosus and biceps to patella	2	1	1	0
Supracondylar osteotomy	3	3	0	0
Stretching	20	0	3	17
Transplantation of patellar tendon downward (Chandler)	7	7	0	0
Stripping ischial tuberosity	1	0	0	1
Lengthening biceps and semimembranosus with section of semitendinosus	9	4	5	0
Total	81			

the patients both in function and cosmetically. The latter alone, especially in girls, made the operation worth while. The very

Chart V
DEFORMITIES OF THE FOOT

	Operations	Good	Fair	Poor
Varus				
Hoke arthrodesis and transplantation of tibialis anticus to outer foot	6	6	0	0
Transplantation of tibialis anticus to outer foot	7	6	0	1
Hoke arthrodesis	12	10	1	1
Stretching	5	1	2	2
Astragalectomy	2	1	1	0
Equinocavus				
Fasciotomy (Steindler)	4	0	0	4
Hoke arthrodesis and lengthening of tibialis anticus	7	6	0	1
Lambrinudi arthrodesis	2	2	0	0
Calcaneus (following lengthening tendo Achilles) 8 cases				
Astragalectomy	4	2	2	0
Total	49			

best results were obtained by accompanying the transplant with arthrodesis of the wrist. Arthrodesis of the wrist is a very difficult thing to do because of the extreme

Chart VI
FLEXION DEFORMITY OF WRIST

	Operations	Good	Fair	Poor
Stretching of wrist	12	0	1	11
Transplantation of both flexor carpi tendons to extensors of fingers	16	5	10	1
Transplantation of ulna flexor carpi tendon to extensors of fingers	7	2	4	1
Arthrodesis	8	2	2	4
Arthrodesis and tendon transplant	3	2	1	0
Lengthening of flexor tendons	2	0	1	1
Stoffel operation to flexors of wrist and fingers	1	1	0	0
Total	49			

muscle pull. The majority had recurrence of deformity. It is now felt that an extensive fusion of the wrist with a graft is necessary in most cases. (Figs. 25 and 27.) Stretching of the wrist and fingers alone has been worthless, as has been lengthening of the flexor tendons. In regard to Stoffel's operation in the arm and forearm, only two cases were done with great improvement. It is felt that more of these should be done than we have here.

For pronation deformity, the Tubby operation has been successful. (Chart VII.) Whether or not this may be considered a functioning transplant, one cannot be certain. There have been recent operative cases not included, in which the pronator teres was merely sectioned with good results to date.

One patient with very severe spasmodic torticollis was admitted. He was unable to get about because of violent contraction of the trapezius. Section of the spinal accessory and muscular branches of the third and fourth cervical motor branches resulted in marked improvement. The patient has been able to go about with a brace to hold his head erect and is gradually

Fig. 19. Spastic flexion of knees and biceps transplant, right.

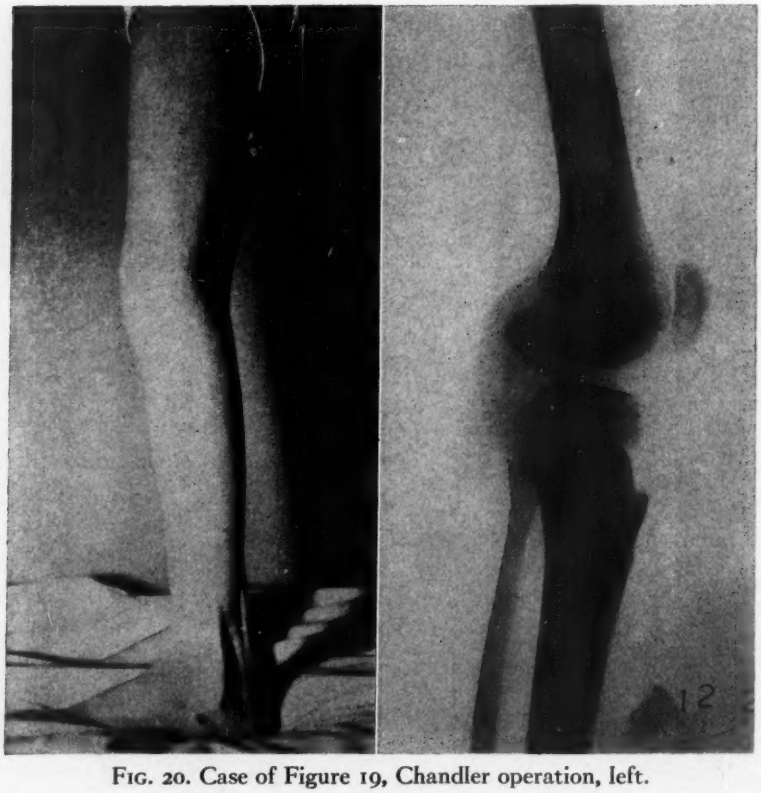


Fig. 20. Case of Figure 19, Chandler operation, left.

developing muscle power on the unaffected side sufficient to hold his head up for a short time.

CHART VII
PRONATION DEFORMITY

	Operations	Good	Fair	Poor
Pronator teres transplant (Tubby)	4	3	1	0
DEFORMITY OF HAND				
Flexion of thumb				
Transplantation of extensor indicis to extensor pollicis	1	1	0	0
Adduction of thumb				
Section of adductor pollicis	1	1	0	0
Adduction of thumb with spasm of interossei muscles				
Section of deep motor branch of ulnar nerve at wrist	1	1	0	0
SPASM OF NECK				
Section spinal accessory nerve and third and fourth cervical roots	1	0	1	0

Hip flexion deformity has not been corrected as frequently as it is seen. (Chart VIII.) Stretching was of no use in most cases. When the deformity was corrected by the Soutter operation, the results were much better. This operation seems to be of more value in spastics than in poliomyelitis as it tends to equalize muscle balance.

CHART VIII
DEFORMITIES OF HIP

	Operations	Good	Fair	Poor
Flexion				
Stretching	7	1	0	6
Soutter operation	8	6	0	2
Subluxation				
Reconstruction of acetabulum	2	1	1	0
Total	17			

CHART IX
DEFORMITIES OF TOES

	Operations	Good	Fair	Poor
Hyperextension of great toe				
Transplantation extensor hallucis longus with fusion of interphalangeal joint	3	3	0	0
Flexion of great toe				
Tenodesis of extensor tendon	1	1	0	0
Fusion of metatarsophalangeal joint	1	0	0	1
Hammer toe				
Fusion of interphalangeal joint	3	0	0	3
Claw toes				
Transplantation extensor tendons to metatarsals	1	0	0	1
Stretching toes	1	0	0	1

Deformities of the toes are frequently seen and are very troublesome. (Chart IX.) Transplantation of tendons and relief of spasm by Stoffel operation offer the best means of treatment. Fusion of interphalangeal joints in small toes has always been a failure because of the inability to

CHART X
SYMPATHETIC RAMISECTION

	Operations	Good	Fair	Poor
Lumbar	3	0	0	3
Cervical	5	0	1	4
Done at Ruptured and Crippled by Dr. Royle in 1924	2	0	0	2

CHART XI
DEATHS

Posterior bone block	1
Obturator nerve resection	2
Lengthening of tendon of Achilles	1
Biceps transplant	1
Sympathetic ramisection	1
Total	6

maintain the position in the presence of such spasm.

Several years ago, during the height of popularity, sympathetic ramisection was done in a few cases. (Chart x.) Permanent relief was given to only one and that could be noticed by the patient alone. All the patients felt increased warmth in the parts, but this was only temporary also.

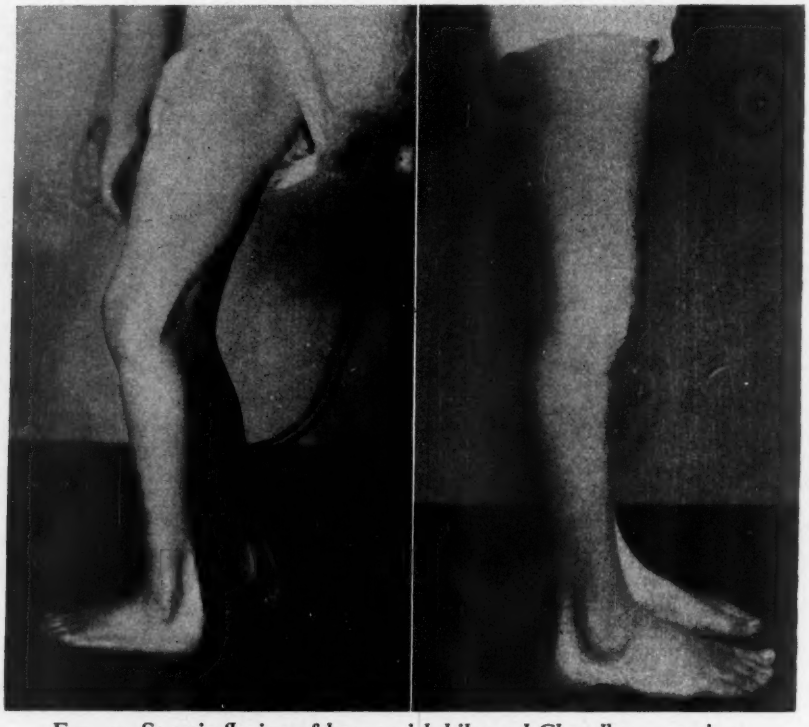


Fig. 21. Spastic flexion of knees with bilateral Chandler operation.

Fig. 22. Postoperative *x*-ray of patient in Figure 21.

Two patients operated on by Dr. Royle in 1924 also had no improvement.

Out of a total of 554 operations done on 210 patients, there were six deaths. (Chart xi.) One died of postoperative pneumonia and one of scarlet fever arising shortly after operation. Four others died from four to eight days after operation, after a sudden marked rise in temperature, one going as high as 110 degrees. It is felt that there is a disturbance in the heat regulating centers, as one of the patients who died had a similar reaction after a previous operation, but had recovered. Also it has been noted that many spastic children have an acetone urine for several days after operation in spite of good postoperative care.

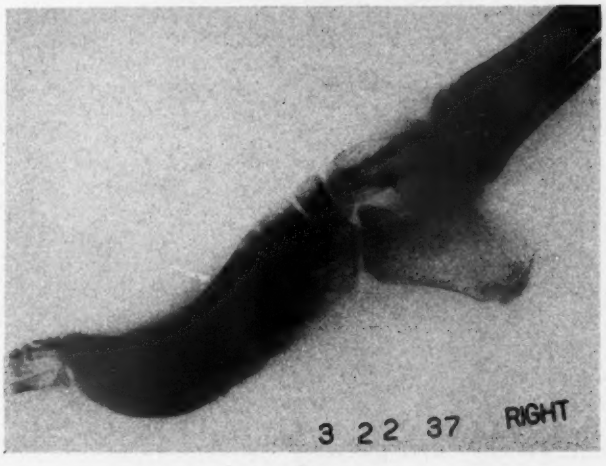
SUMMARY

From this review of the literature and end result study, the conclusion has been reached that the treatment of cerebrospinal spastic paralysis, as a whole, has not changed a great deal. From time to

time, new procedures have been added, each of which has offered something, but nothing specific. It has given the impression of the favorable cases and commitment of the others.

Reëducation has been definitely accepted

A



B

Fig. 23. Fixed equinus deformity.

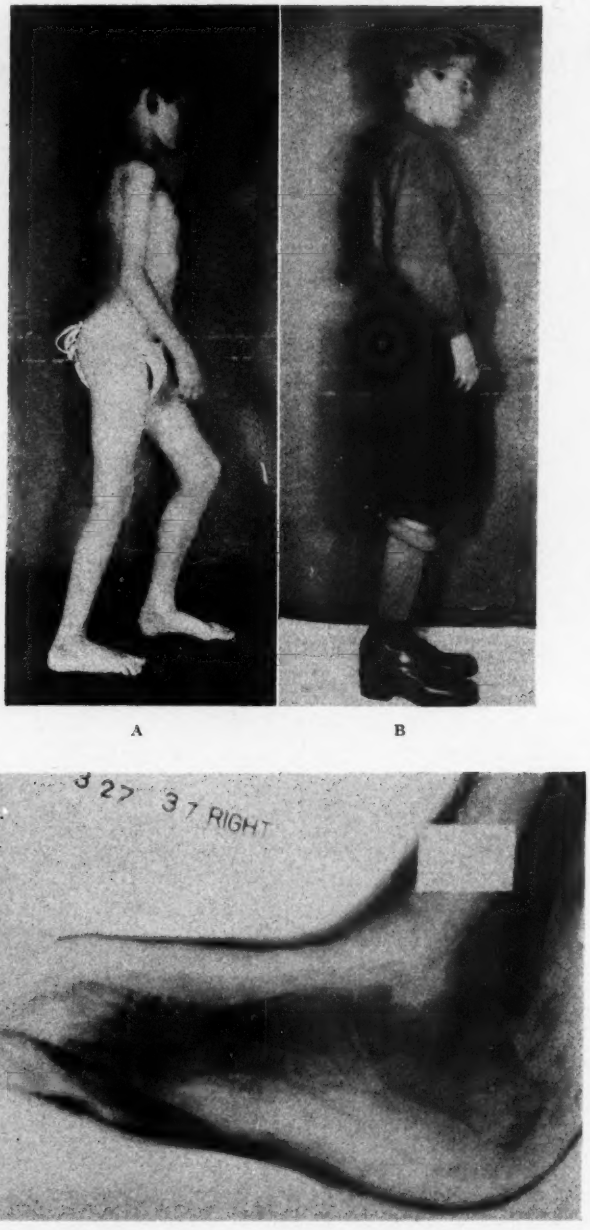
sion that these patients have become a great problem to society as well as to medicine, and that greater interest is being taken to classify them into groups according to the prognosis for improvement. Various communities are organizing groups and clinics for their examination and treatment, and institutions are being established for the treatment and education as a means of rehabilitation of these patients accompanied by surgical interference as an adjunct, or to correct disabilities or deformities which could not be aided in a conservative way.

The operation of posterior root section of Foerster, though reported as successful by many writers, is not generally done, and its permanent results are doubtful. It is a

serious operation with a definite mortality, and should only be considered in the very severe cases of spasticity which have marked sensory irritability.

tion. In the milder cases, these operations have given complete relief and removed the disability.

There is no doubt that decompression



A B C

Fig. 24. Case of Figure 23, Lambrinudi operation.

Procedures done on the peripheral nerves according to Stoffel and modifications have proved with time to be of great value and are easily done by good surgical technicians. The relief of marked spasm causing imbalance of power at a joint has been a tremendous aid to muscle reëduca-

operations have their place in the cases of children showing increased intracranial pressure which cannot be relieved by other methods, and in those children having localized meningeal hemorrhage at birth, to prevent subsequent brain damage. Of course, the diagnosis here will depend on

the alertness of the obstetrician. In the late cases, after the pathology has become static, the benefit is only slight. Many logic basis on which it is done is still uncertain. The few cases seen and reviewed were not benefited sufficiently or permanently,

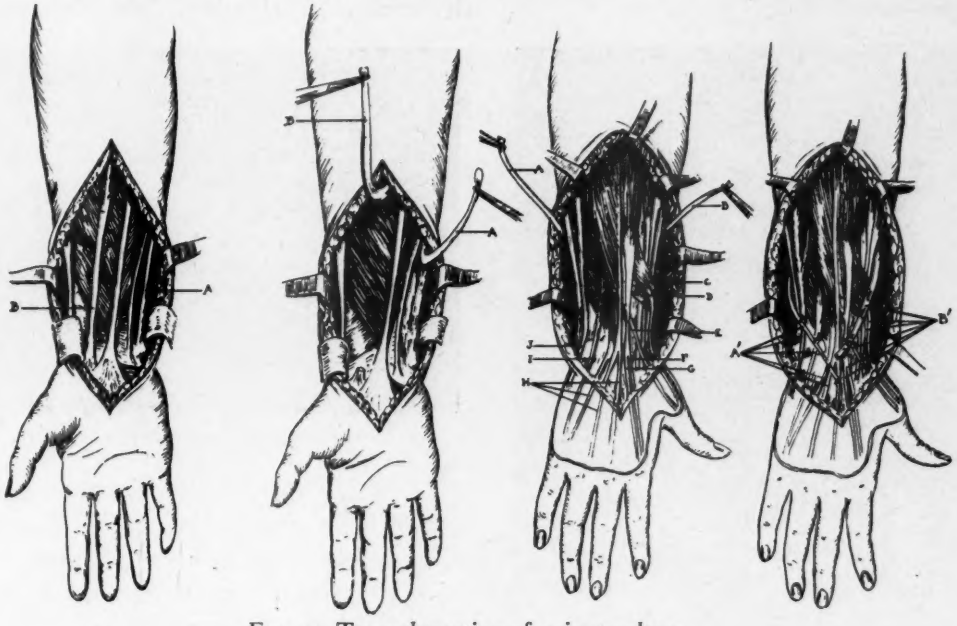


Fig. 25. Transplantation of wrist tendons.

operations have relieved patients of epileptiform seizures, which certainly make it worthwhile for the family if not for the and one cannot say the operation was worth doing. The patients were temporarily relieved and felt more comfortable for a

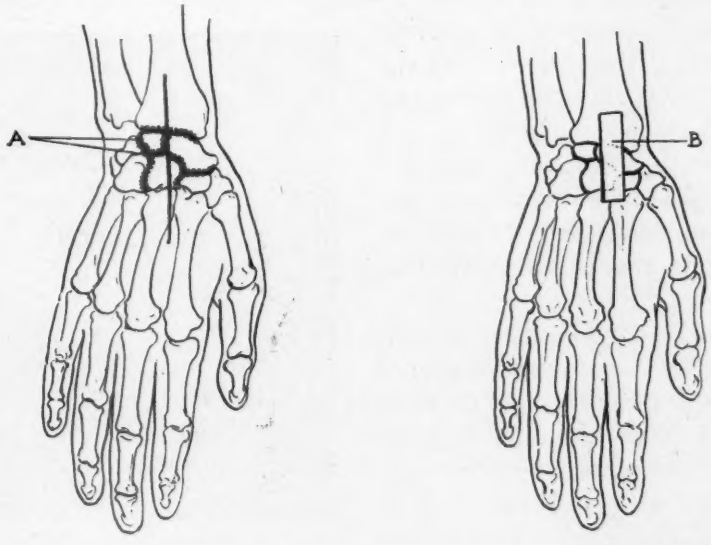


Fig. 26. Arthrodesis of the wrist.

patient, even though the spasticity remains the same afterward.

As for sympathetic ramisection, one hardly knows what to say because of the marked difference of opinion. The physiofew months. It is possible this could all have been brought about by increased circulation in the extremities. We all know that spastic patients feel freer and easier in a warm pool and most seem to do better

with muscle reëducation in the summer than the winter. It is a major surgical procedure with doubtful results, and so is not recommended.

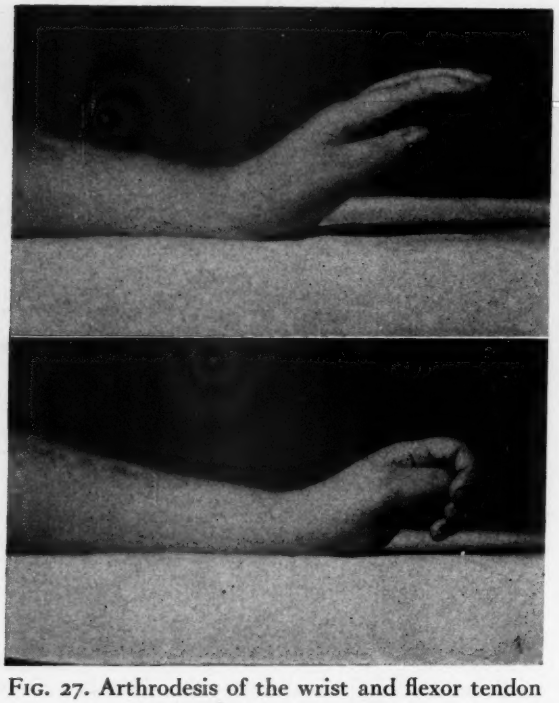


FIG. 27. Arthrodesis of the wrist and flexor tendon transplant to extensors.

The treatment of athetosis by section of the extrapyramidal tracts is still in the experimental stage by the originator and others, so should not be evaluated.

It seems that the bulk of these cases will continue to fall into the hands of the orthopedic surgeons for relief of spasticity in individual muscle groups to prevent or correct deformity.

When the disability is equinus of the foot, it is concluded that muscle balance should be the goal. If this is not accomplished by nerve section, the foot must be held by a brace or splint, or recurrence must be expected in many cases. Frequently, muscle balance can be permanently obtained by the Stoffel operation on the nerve to both heads of the gastrocnemius. If there is contracture, stretching or lengthening of the tendon of Achilles must be done. The posterior bone block of Wagner type offers a splendid means of preventing spastic contracture of calf muscles in older children and adults.

The correction of spastic adduction deformity of the legs can be well taken care of by resection of both rami of the obturator nerve and section of the adductor longus. No ill results were seen.

FIG. 28. Arthrodesis of the wrist.

A definite program should be followed when flexion deformity of the knee is present. At first the deformity should be corrected. If this cannot be done by stretching, then supracondylar osteotomy may be performed. When healed, usually it will be noticed that the patella is higher than normal from an elongated patellar tendon. The Chandler operation has been successful for the correction of this. Later, if muscle balance is not present, trans-

FIG. 29. Wrist flexor tendon transplant to extensors.

plantation of the biceps muscle may be done to give added power to the extensors. Tenotomy, in addition, of the semitendinosus has produced no ill effects and given better balance.

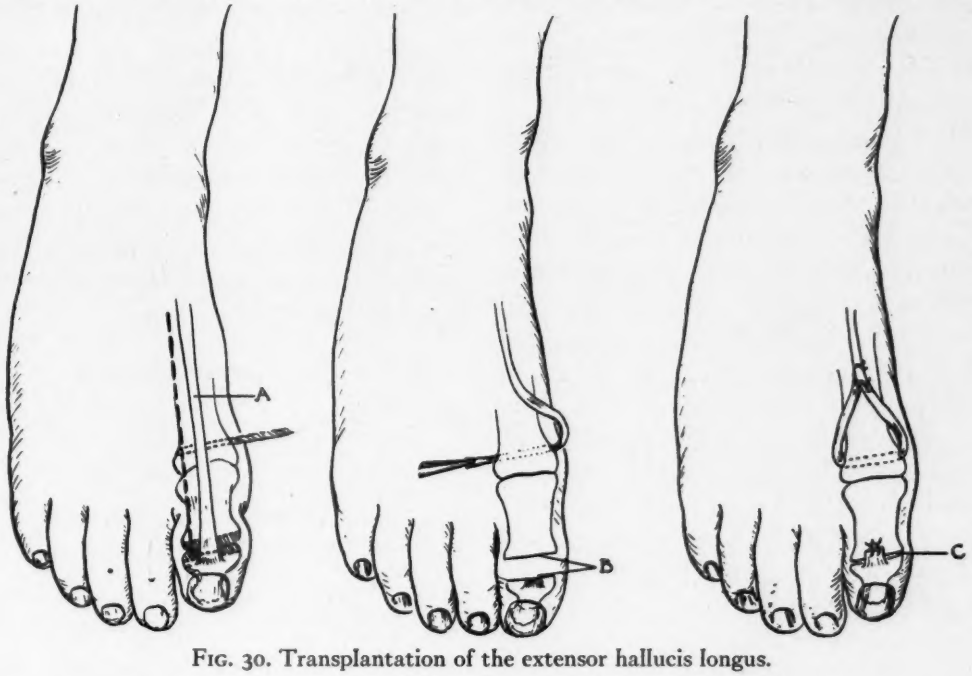


Fig. 30. Transplantation of the extensor hallucis longus.

When deformities of the foot are present, bony operations for correction and stabilization should be done. At the same time, any deforming spastic tendon should be transplanted, as is often the case of the anterior tibial.

The production of a good functioning hand by any procedure in spastics is only occasional, although marked improvement is possible. In cases where the fingers function fairly well but the wrist is in marked flexion, an arthrodesis may give tremendous improvement. The latter is difficult to obtain, and a thorough operation with bone graft is usually necessary. Transplantation of the flexor tendons of the wrist to the extensors of the fingers has given fair results. A combination of arthrodesis and tendon transplant has been quite successful. Stoffel operations are recommended on nerves to flexors of the fingers for release of spasm.

In the majority of these cases with wrist deformity, there is also pronation. The Jones operation is recommended by Wilson, as it releases pronation and gives added strength to the extensors. The Tubby operation has been successful for pronation but simple tenotomy of the pronator teres may be as effective.

Flexion deformity of the hips is a frequent condition, but, unless marked, is not disabling. The Soutter operation has properly taken care of the condition. Stretching may be helpful in mild cases.

In regard to the toes, hyperextension of the great toe is frequently seen and not much has ever been done about it. Transplantation of the extensor hallucis longus tendon to the neck of the first metatarsal has completely relieved the patients. Other operations on the toes have not been successful, so it is felt that Stoffel operation on the nerves to the toe flexors, though not frequently done, would be of great value.

The authors wish to stress the proper protection of limbs by braces or splints over a sufficiently long period after operation has been done, so that patients may become adjusted to their new positions and obtain reëducation of transplanted muscles.

CONCLUSIONS

1. A postoperative end result study has been made of 210 patients with cerebrospinal spastic paralysis.

2. An evaluation of 554 operations done on these patients was made.

3. For equinus deformity of the foot, Stoffel operation on the nerves to the gastrocnemius with heel cord lengthening when necessary was the best method of obtaining muscle balance. This balance should be maintained by muscle training, application of a brace, or by a posterior bone block of Wagner type.

4. Adduction deformity of the legs was best relieved by complete resection of the obturator nerve and section of adductor longus.

5. For flexion of the knee, correction of fixed deformity is first necessary by stretching or supracondylar osteotomy. Following this, reëstablishment of normal leverage of the patella is obtained by Chandler operation. If, after muscle training, the quadriceps is still weak, this should be reinforced by biceps transplant. Stoffel operation on nerves to remaining hamstrings or section of semitendinosus may be done.

6. Deformities of the foot are best corrected by bony operation and stabilization. Removal or transplantation of deforming muscles should be done.

7. For simple flexion deformity of the wrist, arthrodesis is an excellent procedure. When the fingers are involved, transplantation of the flexors of the wrist to the extensors of the fingers with arthrodesis of the wrist has given fair results. Stoffel operation on nerves to finger flexors is beneficial to relieve extreme spasm.

8. Pronation deformity may be relieved by Tubby operation or section of pronator teres.

9. Soutter operation offers the best method of correction of hip flexion.

10. Hyperextension of the great toe can be corrected by transplantation of the extensor hallucis longus to the neck of the metatarsal with fusion of the interphalangeal joint.

11. Sympathetic ramisection has offered no permanent relief to nine patients out of ten.

12. A certain number of cerebrospastic patients will die postoperatively from some unknown cause, possibly disarrangement of the heat regulating centers.

13. All patients should have an observation period of muscle training before operation and adequate training afterward, for rehabilitation.

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